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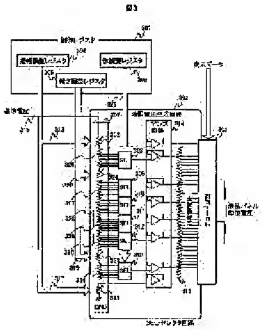
(54) LIQUID CRYSTAL DRIVING DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE



(57)Abstract:
PROBLEM TO BE SOLVED: To actualize high picture quality and versatility by adjusting gamma characteristics corresponding to individual characteristics of a liquid crystal panel most suitably and easily by making three kinds of adjustments, i.e., amplitude, gradient, and fine adjustments of the gamma characteristics.

SOLUTION: A device of the present invention is equipped with ladder resistances 326 to 330 which divide a reference voltage, a resistance dividing circuit which divides the voltages divided by the ladder resistances, selector circuits 308 to 313 which select gradation voltages out of the voltages divided by the resistance dividing circuit, a 1st variable resistance 322 which is positioned between the ladder resistances and reference voltage, a 2nd variable resistance 321 which is positioned between the ladder resistances and ground, and 3rd variable resistances 323 and 324 which are positioned between the ladder resistances.

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CLAIMS

[Claim(s)]
[Claim 1] The liquid crystal driving gear equipped with the selector circuit which chooses said gradation electrical potential difference, and the variable resistance located between said ladder resistance and said reference voltages in the liquid crystal driving gear which generates the gradation electrical potential difference according to an indicative data, and is outputted to a liquid crystal panel from the ladder resistance which carries out resistance division of the reference voltage, and the electrical potential difference in which resistance division was carried out by said ladder resistance according to the indicative data.
[Claim 2] The liquid crystal driving gear [equipped with the adjustment register for adjusting the resistance of said variable resistance] according to claim 1.
[Claim 3] Said adjustment register is a liquid crystal driving gear according to claim 2 with which the amplitude on the graph of the relation between a gradation number and a gradation electrical potential difference is set up.
[Claim 4] The liquid crystal driving gear equipped with the variable resistance located between the selector circuit which chooses said gradation electrical potential difference, and said ladder resistance and gland in the liquid crystal driving gear which generates the gradation electrical potential difference according to an indicative data, and is outputted to a liquid crystal panel from the ladder resistance which carries out resistance division of the reference voltage, and the electrical potential difference in which resistance division was carried out by said ladder resistance according to the indicative data.
[Claim 5] The liquid crystal driving gear [equipped with the adjustment register for adjusting the resistance of said variable resistance] according to claim 4.
[Claim 6] Said adjustment register is a liquid crystal driving gear according to claim 5 with which the amplitude on the graph of the relation between a gradation number and a gradation electrical potential difference is set up.
[Claim 7] The liquid crystal driving gear equipped with the selector circuit which chooses said gradation electrical potential difference, and the variable resistance located among said two or more ladder resistance in the liquid crystal driving gear which generates the gradation electrical potential difference according to an indicative

data, and is outputted to a liquid crystal panel from two or more ladder resistance which carries out resistance division of the reference voltage, and the electrical potential difference in which resistance division was carried out by said ladder resistance according to the indicative data.

[Claim 8] The liquid crystal driving gear [equipped with the adjustment register for adjusting the resistance of said variable resistance] according to claim 7.

[Claim 9] Said adjustment register is a liquid crystal driving gear according to claim 8 with which the inclination on the graph of the relation between a gradation number and a gradation electrical potential difference is set up.

[Claim 10] The liquid-crystal driving gear equipped with the ladder resistance which carries out resistance division of the reference voltage, the resistance dividing network which carries out resistance division of the electrical potential difference in which division at the appointed hour was carried out by said ladder resistance, and the selector circuit which chooses said gradation electrical potential difference from the electrical potential difference by which resistance division was carried out according to the indicative data in said dividing network at the appointed hour in the liquid-crystal driving gear which generates the gradation electrical potential difference according to an indicative data, and is outputted to a liquid crystal panel.

[Claim 11] The liquid crystal driving gear [equipped with the adjustment register for adjusting said resistance dividing network] according to claim 10.

[Claim 12] In the liquid crystal driving gear which generates the gradation electrical potential difference according to an indicative data, and is outputted to a liquid crystal panel Two or more ladder resistance which carries out resistance division of the reference voltage, and the resistance dividing network which carries out resistance division of the electrical potential difference in which division at the appointed hour was carried out by said ladder resistance, The selector circuit which chooses said gradation electrical potential difference from the electrical potential difference by which resistance division was carried out in said dividing network at the appointed hour according to an indicative data, The liquid crystal driving gear equipped with the 1st variable resistance located between said ladder resistance and said reference voltages, the 2nd variable resistance located between said ladder resistance and glands, and the 3rd variable

resistance located among said two or more ladder resistance.
[Claim 13] In the liquid crystal display equipped with the liquid crystal panel, the liquid crystal actuation circuit which outputs a gradation electrical potential difference to said liquid crystal panel according to an indicative data, and the scanning-line actuation circuit which drives the scan line on said liquid crystal panel which outputs said gradation electrical potential difference Two or more ladder resistance said whose liquid crystal actuation circuits carry out resistance division of the reference voltage, The resistance dividing network which carries out resistance division of the electrical potential difference in which division at the appointed hour was carried out by said ladder resistance, The selector circuit which chooses said gradation electrical potential difference from the electrical potential difference by which resistance division was carried out in said dividing network at the appointed hour according to an indicative data, The liquid crystal display equipped with the 1st variable resistance located between said ladder resistance and said reference voltages, the 2nd variable resistance located between said ladder resistance and glands, and the 3rd variable resistance located among said two or more ladder resistance.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention generates the gradation electrical potential difference according to an indicative data, relates to the liquid crystal display equipped with the liquid crystal driving gear outputted to a liquid crystal panel, and its liquid crystal driving

gear, and relates to the liquid crystal display especially equipped with the liquid crystal driving gear which can be adjusted and its liquid crystal driving gear of a gamma property.
[0002]
[Description of the Prior Art] In order to display an indicative data on a liquid crystal panel by high definition first, it is necessary to adjust a desired gamma property according to the property of liquid crystal panel each. Also in the conventional technique, the liquid crystal display which can adjust this gamma property is indicated.
[0003] A general gamma property is first explained using drawing 1 . In drawing 1 , (a) shows an applied-voltage-brightness property in case the mode of a liquid crystal panel is NOMA reeve rack mode, and in low applied voltage, it becomes low brightness, and it becomes high brightness with high applied voltage. As a description, it is mentioned in a low applied-voltage field and a high applied-voltage field that the brightness change to applied voltage will be in a blunt (saturation) condition.
[0004] Moreover, although there is a liquid crystal panel in no MARI White mode other than the liquid crystal panel in the above-mentioned NOMA reeve rack mode, it explains for the liquid crystal panel in NOMA reeve rack mode below. In addition, in this invention, it can carry out regardless of the mode of the above-mentioned liquid crystal panel.
[0005] Next, drawing 1 (b) shows a gradation number-brightness property. Usually, this property is called the gamma property. Here, to the increment in a gradation number, 101 of drawing 1 (b) shows the property that brightness rises to a linear, and calls this property the property of gamma= 1.0. This gamma value is realized with the relational expression of following the (1) type here.
[0006]
(Gradation number) gamma= brightness [cd/m2] ... (1)
From the above-mentioned (1) formula, 102 of drawing 1 (b) and 103 show the property of gamma= 2.2 and gamma= 3.0, respectively. When an indicative data is conventionally displayed on a liquid crystal panel here, generally the property sensed that the display image is high definition most by people's eyes is at the time of gamma= 2.2 of the above 102.
[0007] The liquid crystal display is adjusting the above-mentioned gamma property by adjusting applied voltage for every gradation number here. Drawing 1 (c) is related drawing of the above-mentioned gradation number-applied voltage, and is the case where the number of gradation is made into 64 gradation. When the applied-voltage-brightness properties

shown by drawing 1 here differ in liquid crystal panel each, and are made into an example and applied voltage is doubled with the above gamma= 2.2, the adjustment values of the applied voltage differ by liquid crystal panel each. 104 of drawing 1 (c) is related drawing of the gradation number-applied voltage at the time of considering as the above gamma= 2.2. 105 and 106 are related drawings of the gradation number-applied voltage at the time of being referred to as gamma= 2.2 in a different liquid crystal panel from 104, respectively. Thus, the gradation electrical-potential-difference generation circuit which doubles this applied voltage (a gradation electrical potential difference is called hereafter.) with the property of liquid crystal panel each in a liquid crystal display, and can be adjusted to a desired gamma property is needed.

[0008] Next, as an example of the liquid crystal display which can adjust the gamma property mentioned above, there is JP,2001-181102,A "the liquid crystal display using the source driver for liquid crystal displays and it."

[0009] Hereafter, actuation of the above-mentioned conventional example is briefly explained using drawing 17 .

[0010] In drawing 17 , 302 is a gradation electrical-potential-difference generation circuit, and this gradation electrical-potential-difference generation circuit consists of the control register 301 for gamma adjustment and ladder resistance 307 constituted by the variable resistance of 1701-1709, an amplifier circuit 314, and output section ladder resistance 315. Moreover, 303 is a decoding circuit which decodes the gradation electrical potential difference according to an indicative data from the gradation electrical potential difference generated in the gradation electrical-potential-difference generation circuit 302. The gradation electrical-potential-difference generation circuit 302 detects the resistance setting-out data contained in the indicative data with the control register 301 for gamma corrections, and sets up the resistance of the variable resistance 1701-1709 of the ladder resistance 307 with the detected resistance setting-out data here. This ladder resistance 307 carries out resistance division of between the reference voltage 316 supplied from the outside, and GND by the variable resistance 1701-1709 by which resistance setting out was carried out with the previous control register 301 for gamma corrections, and generates the gradation electrical potential difference of ten points among 64 gradation electrical potential differences here. The gradation electrical potential difference of ten points generated by this ladder resistance 307 is buffered in the latter amplifier circuit 314, carries

out resistance division of the previous gradation electrical potential difference of ten points further by the output section ladder resistance 315, and generates 64 desired gradation electrical potential differences. Next, the gradation electrical potential difference which suited the indicative data in this 64 gradation electrical potential difference in the decoding circuit of 303 is chosen.

[0011] A Prior art possesses the gradation electrical-potential-difference generation circuit 302 in a liquid crystal display as mentioned above. By setting up with the control register 301 for gamma corrections, the resistance of nine variable resistance 1701-1709 which constitutes the ladder resistance 307 of this gradation electrical-potential-difference generation circuit 302 interior By changing the resistance split ratio, it was what the reference voltage 316 of the ladder resistance 307 and each gradation electrical potential difference generated from between GND are changed, and adjusts each gradation electrical potential difference according to the gamma property of the request in the property of liquid crystal panel each.

[0012]

[Problem(s) to be Solved by the Invention] With the above-mentioned conventional technique, the electrical potential difference of the ends of 107 shown in drawing 1 (c) among 64 gradation electrical potential differences and the gradation number 108 is considered as immobilization, and it was considering as the reference voltage 316 supplied from GND or the outside, respectively. In this case, another equalization circuit is needed for the exterior of the gradation electrical-potential-difference generation section 302, and the gradation electrical potential difference which cannot adjust the gradation electrical potential difference considered as GND immobilization, and is considered as reference voltage 316 immobilization becomes an increase of the number of components, when performing that adjustment. As it was called the relation of 104, 105, and 106 of drawing 1 (c) here, the case where the electrical potential difference of the ends of a gradation number had to be adjusted was produced according to a difference of the property of a liquid crystal panel, and it was not taken into consideration about these cases with the above-mentioned conventional technique.

[0013] there be a means give an offset adjustment (amplitude electrical potential difference of gradation electrical potential difference presuppose that it be fixed , and shift that property to y shaft orientations) function to the amplifier circuit 314 indicate by JP,11-175027,A as a means solve the above-mentioned problem , and adjust the electrical potential difference of the ends of a gradation number , and

an offset equalization circuit be needed for the amplifier circuit 314 interior in this case , therefore , as for circuit magnitude , a large next door and cost also become high . Moreover, it is the configuration which possesses nine variable resistance 1701-1709 in the ladder resistance 307, sets up the resistance of all those variable resistance with the control register 301 for gamma corrections with said conventional technique, and is adjusted to a desired gamma property. If one variable-resistance value is adjusted in this configuration, the whole resistance split ratio will change and all gradation electrical potential differences will change in connection with this. Therefore, for adjusting a gradation electrical potential difference, much time amount is required so that it may be thoroughly in agreement with each property like drawing 1 (c)104-106.

[0014] The object of this invention is offering the liquid crystal driving gear and liquid crystal display which realize high definition.

[0015]

[Means for Solving the Problem] In order to double with a difference of the property of the liquid crystal panel which was the above-mentioned technical problem and to enable adjustment of the electrical potential difference of the ends of a gradation number, in this invention, variable resistance was installed in the both ends (between the reference voltage supply from the outside, and GND) of ladder resistance, respectively, and it considered as a ladder resistance configuration which generates the electrical potential difference of 107 of drawing 1 (c), and the ends of the gradation number 108, from the electrical potential difference by which resistance division was carried out by the variable resistance. Moreover, setting out of the resistance of the above-mentioned variable resistance was enabled with the register (it is called an amplitude adjustment register.), and adjustment was made possible by this ladder resistance also with the offset adjustment in an amplifier circuit in the conventional technique.

[0016] Here, in this invention, it considered not only as **** but as the ladder resistance configuration which can adjust a gradation electrical potential difference by register setting out also in other gradation electrical potential differences. Each of that content of adjustment is explained using drawing 2 . Drawing 2 (a) shows the gradation number-gradation voltage characteristic of each **** which set up the variable-resistance value of the both ends of ladder resistance with the amplitude adjustment register. It is property drawing at the time of being the case where the electrical-potential-difference value of a side with 201 [low / a gradation electrical potential difference]

changed the electrical-potential-difference value of a high side, without making it change, and the amplitude electrical potential difference of a gradation electrical potential difference is adjusted, and the electrical-potential-difference value of a side with 202 [high / a gradation electrical potential difference] changing the electrical-potential-difference value of a low side, without making it change, and adjusting the amplitude electrical potential difference of a gradation electrical potential difference here. 201 and 202 are the cases where only one side (a reference voltage side or the GND side) is set up for the variable-resistance value of the both ends of the above-mentioned ladder resistance with an amplitude adjustment register. Moreover, 203 is property drawing at the time of setting up simultaneously the variable-resistance value of the both ends of the above-mentioned ladder resistance with an amplitude adjustment register. In this case, the same operation as the offset adjustment which was being performed in the conventional technique in the amplifier circuit is acquired.

[0017] Next, 204 of drawing 2 (b) is property drawing at the time of adjusting the inclination property of the medium (halftone) section of the gradation number of the gradation number-gradation voltage characteristic. This adjustment can be adjusted by enabling setting out of the resistance of the variable resistance which generates the gradation electrical potential differences 205 and 206 which determine the inclination property in ladder resistance with an inclination adjustment register.

[0018] As mentioned above, the gradation electrical potential difference doubled with the property of each liquid crystal panel called 104-106 of drawing 1 (c) with the amplitude adjustment register and the inclination adjustment register can be set up roughly. Thereby, adjustment of the gamma property of the request according to the property of each liquid crystal panel can be performed easily, and adjustment time amount can be shortened.

[0019] Next, 207 of drawing 2 (c) is gradation number-gradation voltage characteristic drawing at the time of tuning each gradation electrical potential difference finely. This fine adjustment carries out that fine adjustment is possible by carrying out the ** value of the resistance dividing network for performing resistance division further between each gradation electrical potential difference by which resistance division was carried out by the above-mentioned variable resistance, and carrying out as the configuration which can choose a desired gradation electrical potential difference with the set point of a fine adjustment register out of each electrical-potential-difference value generated by that

resistance division. When changing one variable-resistance value which was the above-mentioned technical problem by this configuration, resistance division of between each gradation electrical potential difference in which resistance division was carried out by this variable resistance is carried out still more finely, by choosing a desired electrical-potential-difference value out of it, another gradation electrical potential difference is not not much changed, and adjustment only of a desired gradation electrical potential difference is attained. Moreover, adjustment of a gamma property is made into what has a more high precision, and high definition-ization can be desired by enabling fine adjustment of each gradation electrical potential difference as mentioned above.

[0020] As mentioned above, in adjustment of a gamma property, by each setting out of an amplitude register and an inclination register, adjustment of a gamma property shall be made easy and adjustment time amount shall be shortened by considering as the ladder resistance configuration which can adjust the amplitude electrical potential difference of the gradation electrical potential difference according to the property of liquid crystal panel each, and a rough gradation electrical potential difference called the inclination property of the halftone section. Moreover, by providing a fine adjustment register, adjustment precision shall be raised, and high definition-ization shall be desired by considering as the configuration which can tune finely further to the gradation electrical potential difference adjusted with the above-mentioned amplitude register and the inclination register, and the degree of freedom of an adjustable range shall have increase and versatility.

[0021]

[Embodiment of the Invention] The configuration of the liquid crystal display by the 1st operation gestalt of this invention is explained using drawing 10 from drawing 3 .

[0022] Drawing 3 is the block diagram of the gradation electrical-potential-difference generation circuit of this invention. It is the decoding circuit which decodes the gradation electrical potential difference which doubled the control register holding the set point for 301 to adjust a gamma property, and 302 with the gradation electrical-potential-difference generation circuit, and doubled 303 with the indicative data. A control register 301 is a configuration containing the above-mentioned amplitude adjustment register 304, the inclination adjustment register 305, and the fine adjustment register 306 here.

[0023] Moreover, the gradation electrical-potential-difference

generation circuit 302 Each gradation electrical potential difference from between the reference voltage 316 supplied from the outside, and GND The ladder resistance 307 to generate and this ladder resistance 307 The resistance dividing networks 326-331 for carrying out resistance division of the variable resistance 321-324 to constitute and the electrical potential difference by which resistance division was carried out in that variable resistance further, and the gradation electrical potential difference generated in these resistance dividing networks 326-331 with the set point of the fine adjustment register 306 the selector circuits 308-313 to choose and the amplifier circuit 314 which buffers the output voltage of each of that selector circuit -- and It is constituted by the output section ladder resistance 315 which carries out resistance division by the gradation electrical potential difference for several gradation minutes (considering as an example here 64 gradation electrical potential differences) of a request of the amplifier circuit 314 output voltage.

[0024] The bottom variable resistance 321 currently installed in the ladder resistance 307 bottom here considers as the configuration which can set up the resistance with the bottom variable-resistance set point 317 of the amplitude adjustment register 304, and upside variable resistance 322 currently installed in the ladder resistance 307 upside is taken as the configuration which can set up the resistance with the upside variable-resistance set point 318 of the amplitude adjustment register 304. The electrical potential difference in which resistance division was carried out by both this variable resistance 321,322 is made into the gradation electrical potential difference of the ends of a gradation number, and it considers as the configuration which can set up amplitude adjustment of a gradation electrical potential difference with the amplitude adjustment register 304.

[0025] Moreover, the pars intermedia bottom variable resistance 323 currently installed in the pars intermedia lower berth of the ladder resistance 307 considers as the configuration which can set up the resistance with the pars intermedia bottom variable-resistance set point 319 of the inclination adjustment register 305, and pars intermedia upside variable resistance 324 currently installed in the ladder resistance 307 pars-intermedia upside is taken as the configuration which can set up the resistance with the pars intermedia upside variable-resistance set point 320 of the inclination adjustment register 305. The electrical potential difference in which resistance division was carried out by both this variable resistance 323,324 is made into the gradation electrical potential difference of the gradation number

which has determined the inclination property of the halftone section, and it considers as the configuration which can set up the inclination property of a gradation electrical potential difference with the inclination adjustment register 305.

[0026] It considers as the above ladder resistance configurations, and with the amplitude adjustment register 304 and the inclination adjustment register 305, resistance split ratio is changed by setting up the variable-resistance value in ladder resistance, and adjustment of the amplitude electrical potential difference of a gradation electrical potential difference and the inclination property of the halftone section is enabled. (A detail operation is described later.) Moreover, resistance division of between the gradation electrical potential differences generated by the variable-resistance value set up with the amplitude adjustment register 304 and the inclination adjustment register 305, respectively is carried out still more finely by the resistance dividing networks 326-331, and the gradation electrical potential difference for fine adjustment for tuning a gradation electrical potential difference finely is generated. Next, a desired gradation electrical potential difference is chosen for this gradation electrical potential difference for fine adjustment with the set point 325 of the fine adjustment register 306 in each selector circuits 308-313. By this configuration, fine adjustment of each gradation electrical potential difference is enabled, the adjustment precision of a gamma property is raised, and the degree of freedom of adjustment also improves (a detail operation is described later).

[0027] Here, in order that it may be buffered in the latter amplifier circuit 314 and may generate the electrical potential difference of 64 desired gradation, each gradation electrical potential difference generated from **** is the output section ladder resistance 315, carries out resistance division of between each of that gradation electrical potential difference so that electrical-potential-difference relation may become linear, and generates the gradation electrical potential difference for 64 gradation. The gradation electrical potential difference of 64 gradation generated by this in the gradation electrical-potential-difference generation circuit 302 is the decoding circuit 303, decodes the gradation electrical potential difference doubled with the indicative data, and turns into applied voltage to a liquid crystal panel.

[0028] By the above circuitry, it sets to adjustment of a gamma property. By setting out of the amplitude register 304 and the inclination register 305 The ladder resistance which can adjust the amplitude

electrical potential difference of a gradation electrical potential difference and a rough gradation electrical potential difference called the inclination property of the halftone section is included. By considering as the configuration which can tune each gradation electrical potential difference finely further by setting out of the fine adjustment register 306 from between the gradation electrical potential differences generated by the ladder resistance Easy and the gradation electrical-potential-difference generation circuit which can desire high-definition-izing and versatility by being able to shorten adjustment time amount and raising the precision and the degree of freedom of adjustment were realized for adjustment of a gamma property by small circuit magnitude and low cost.

[0029] Next, the variable resistance 321-324 of drawing 3 used with this operation gestalt is explained about actuation of the register set point and variable resistance using drawing 4 . In drawing 4 , 401 shows the internal configuration of the above-mentioned variable resistance 321-324. Here, whenever the set point of a register (the above-mentioned amplitude adjustment register 304 and inclination adjustment register 305) decreases one time, resistance is the example of a configuration of the variable resistance at the time of saying that it carries out the increment in 4R (R: unit resistance). Here, when the register set point is the set point "111 [BIN]", like 402, the switches 403-405 installed in the resistance edge of the variable-resistance 401 interior turn into Switch ON, and the variable-resistance 401 interior will be in a short circuit condition. Therefore, the total resistance of the variable resistance 401 at this time is set to 0R. In addition, each switches 403-405 are controlled for every bit of a register, [1] bit eye of the register set point and the switch 405 of [2] bit eye of the register set point and a switch 404 are [0] bit eyes of the register set point, and a switch 403 controls Switches ON and OFF here, respectively. Next, when the register set point is the set point "000 [BIN]", like 406, the total resistance from which the switches 403-405 installed in the resistance edge of the variable-resistance 401 interior turn into Switch OFF, and the total resistance of variable resistance 401 serves as total of an internal resistance value is set to 28R. The relation of the register set point and the variable-resistance value in the above-mentioned configuration turns into relation shown in 407 here.

[0030] In addition, the relation of the register set point and the variable-resistance value which were shown above is an example of 1 setting out, and when each bit of the register set point is reversed, the relation between the above-mentioned register set point and a

variable-resistance value becomes reverse, and if the register set point increases, it will turn into the relation that the resistance of variable resistance also increases. Thus, the case where relation between the register set point and a variable-resistance value is made into reverse is sufficient. Moreover, although the variable-resistance value-change rate in the register set point is set to 4R for every set point, this value may be made small, or you may enlarge. Here, although precision improves when the change-in-resistance rate for this register setting out of every is made small, when an adjustable range becomes narrow and it is made conversely large, although an adjustable range becomes large, adjustment precision gets worse. Moreover, it is desirable to constitute the unit resistance R used above from several 10komega (the consumed electric current can be lessened). moreover, above-mentioned register setting-out bit -- although the number is set to 3 bits -- this setting-out bit -- a number may be increased. In this case, although the adjustable range of a variable-resistance value becomes large, circuit magnitude increases.

[0031] It is possible to change the resistance of variable resistance by register setting out by the above configuration.

[0032] Next, an adjustment operation of the gamma property by the amplitude adjustment register 304 of drawing 3 and the variable resistance 321 and 322 in the ladder resistance 307 is explained using drawing 5 .

[0033] Drawing 5 (a) shows the adjustment operation at the time of setting up the bottom variable resistance 321 of the ladder resistance 307 of drawing 3 with the amplitude adjustment register 304. 501 is the gradation number-gradation voltage characteristic when the amplitude adjustment register 304 considers as default setting. Here, like 502, the electrical-potential-difference value of a side with a high gradation electrical potential difference should just set up setting out of the amplitude adjustment register 304 to change the electrical-potential-difference value of a low side, and adjust small the amplitude electrical potential difference of a gradation electrical potential difference, without making it change, so that the resistance of the bottom variable resistance 321 may serve as size. Moreover, like 503, the electrical-potential-difference value of a side with a high gradation electrical potential difference should just set up setting out of the amplitude adjustment register 304 to change the electrical-potential-difference value of a low side, and adjust greatly the amplitude electrical potential difference of a gradation electrical potential difference, without making it change, so that the resistance

of the bottom variable resistance 321 may serve as smallness.
[0034] Thus, by changing the resistance of the bottom variable resistance 321 by setting out of the amplitude adjustment register 304, without making it change, the electrical-potential-difference value of a low side is changed, and the electrical-potential-difference value of a side with a high gradation electrical potential difference can adjust the amplitude electrical potential difference of a gradation electrical potential difference.
[0035] Next, (b) of this drawing 5 shows the adjustment operation at the time of setting up the upside variable resistance 322 of the ladder resistance 307 of drawing 3 with the amplitude adjustment register 304. 501 is the gradation number-gradation voltage characteristic when the amplitude adjustment register 304 considers as default setting like the above. Here, like 504, the electrical-potential-difference value of a side with a low gradation electrical potential difference should just set up setting out of the amplitude adjustment register 304 to change the electrical-potential-difference value of a high side, and adjust small the amplitude electrical potential difference of a gradation electrical potential difference, without making it change, so that the resistance of the upside variable resistance 322 may serve as size. Moreover, like 505, the electrical-potential-difference value of a side with a low gradation electrical potential difference should just set up setting out of the amplitude adjustment register 304 to change the electrical-potential-difference value of a high side, and adjust greatly the amplitude electrical potential difference of a gradation electrical potential difference, without making it change, so that the resistance of the upside variable resistance 322 may serve as smallness.
[0036] Thus, by changing the resistance of the upside variable resistance 322 by setting out of the amplitude adjustment register 304, without making it change, the electrical-potential-difference value of a high side is changed, and the electrical-potential-difference value of a side with a low gradation electrical potential difference can adjust the amplitude electrical potential difference of a gradation electrical potential difference.
[0037] Next, (c) of this drawing 5 shows the adjustment operation at the time of setting up simultaneously the bottom variable resistance 321 and the upside variable resistance 322 which were mentioned above with the amplitude adjustment register 304. 501 is the gradation number-gradation voltage characteristic when the amplitude adjustment register 304 considers as default setting like the above. Here, the gradation number-gradation voltage characteristic and an amplitude electrical potential

difference should just set [setting out of the amplitude adjustment register 304] the resistance of size and the upside variable resistance 322 as smallness for the resistance of the bottom variable resistance 321 like 506 to suppose that it is the same as that of 501, and make high an up-and-down gradation electrical-potential-difference value. Moreover, the gradation number-gradation voltage characteristic and an amplitude electrical potential difference should just set [setting out of the amplitude adjustment register 304] the resistance of smallness and the upside variable resistance 322 as size for the resistance of the bottom variable resistance 321 like 507 to suppose that it is the same as that of 501, and make low an up-and-down gradation electrical-potential-difference value.

[0038] Thus, when the bottom and the upside variable resistance 321 and 322 are simultaneously set up by setting out of the amplitude adjustment register 304, it becomes the property which carried out offset adjustment at the gradation number-gradation voltage characteristic at the time of considering as the default setting of the amplitude adjustment register 304.

[0039] The above thing can adjust the amplitude electrical potential difference of the gradation electrical potential difference doubled with the property of liquid crystal panel each with the amplitude adjustment register 304 of drawing 3 .

[0040] Next, an adjustment operation of the gamma property by the inclination adjustment register 305 of drawing 3 and the variable resistance 323 and 324 in the ladder resistance 307 is explained using drawing 6 .

[0041] Drawing 6 (a) shows the adjustment operation at the time of setting up the pars intermedia bottom variable resistance 323 of the ladder resistance 307 of drawing 3 with the inclination adjustment register 305. 601 is the gradation number-gradation voltage characteristic when the inclination adjustment register 305 considers as default setting. Here, like 602, the inclination property of a side with a high gradation electrical potential difference changes the electrical-potential-difference value of a side with a low gradation electrical potential difference, without making it change, and it should just set up setting out of the inclination adjustment register 305 to adjust so that the inclination of the halftone section of a gradation electrical potential difference may become smallness so that the resistance of the pars intermedia bottom variable resistance 323 may serve as size.

[0042] Moreover, like 603, the inclination property of a side with a high gradation electrical potential difference changes the electrical-

potential-difference value of a side with a low gradation electrical potential difference, without making it change, and it should just set up setting out of the inclination adjustment register 305 to adjust so that the inclination of the halftone section of a gradation electrical potential difference may become size so that the resistance of the pars intermedia bottom variable resistance 323 may serve as smallness.

[0043] Thus, by changing the resistance of the pars intermedia bottom variable resistance 323 by setting out of the inclination adjustment register 305, without making it change, the electrical-potential-difference value of a side with a low gradation electrical potential difference is changed, and the inclination property of a side with a high gradation electrical potential difference can adjust the inclination of the halftone section of a gradation electrical potential difference.

[0044] Next, (b) of this drawing 6 shows the adjustment operation at the time of setting up the pars intermedia upside variable resistance 324 of the ladder resistance 307 of drawing 3 with the inclination adjustment register 305. 601 is the gradation number-gradation voltage characteristic when the inclination adjustment register 305 considers as default setting like the above. Here, like 604, the inclination property of a side with a low gradation electrical potential difference changes the electrical-potential-difference value of a side with a high gradation electrical potential difference, without making it change, and it should just set up setting out of the inclination adjustment register 305 to adjust so that the inclination of the halftone section of a gradation electrical potential difference may become smallness so that the resistance of the pars intermedia upside variable resistance 324 may serve as size. Moreover, like 605, the inclination property of a side with a low gradation electrical potential difference changes the electrical-potential-difference value of a side with a high gradation electrical potential difference, without making it change, and it should just set up setting out of the inclination adjustment register 305 to adjust so that the inclination of the halftone section of a gradation electrical potential difference may become size so that the resistance of the pars intermedia upside variable resistance 324 may serve as smallness.

[0045] Thus, by changing the resistance of the pars intermedia upside variable resistance 324 by setting out of the inclination adjustment register 305, it is possible to change the electrical-potential-difference value of a side with a high gradation electrical potential difference, and to adjust the inclination of the halftone section of a

gradation electrical potential difference.
[0046] Next, (c) of this drawing 6 shows the adjustment operation at the time of setting up simultaneously the pars intermedia bottom variable resistance 323 and the pars intermedia upside variable resistance 324 which were mentioned above with the inclination adjustment register 305. 601 is the gradation number-gradation voltage characteristic when the inclination adjustment register 305 considers as default setting like the above. Here, like 606, an inclination property presupposes that it is the same as that of 601, and it should just set [setting out of the inclination adjustment register 305] the resistance of size and the pars intermedia upside variable resistance 324 as smallness for the resistance of the pars intermedia bottom variable resistance 323 to make high the gradation electrical-potential-difference value of the gradation electrical potential difference 608 which determines this inclination property. Moreover, like 607, an inclination property presupposes that it is the same as that of 601, and it should just set [setting out of the inclination adjustment register 305] the resistance of smallness and the pars intermedia upside variable resistance 324 as size for the resistance of the pars intermedia bottom variable resistance 323 to make low the gradation electrical-potential-difference value of the gradation electrical potential difference 608 which determines this inclination property.
[0047] Thus, when the pars intermedia bottom and the pars intermedia upside variable resistance 323 and 324 are simultaneously set up by setting out of the inclination adjustment register 305, the inclination property of the gradation number-gradation voltage characteristic at the time of considering as the default setting of the inclination adjustment register 305 presupposes that it is the same, and turns into a property which adjusted the gradation electrical-potential-difference value of the gradation electrical potential difference 608 which determines this inclination property.
[0048] By the above thing, the amplitude electrical potential difference of the gradation electrical potential difference doubled with the property of liquid crystal panel each is not changed with the inclination adjustment register 305 of drawing 3 , but only the inclination property of the halftone section can be adjusted.
[0049] Next, about the selector circuits 308-313 of drawing 3 used with this operation gestalt, the relation between the set point of the fine adjustment register 306 and selector circuits 308-313 is explained using drawing 7 .
[0050] In drawing 7 , 701 shows the internal configuration of the above-

mentioned selector circuits 308-313. 702 shows the internal configuration of the resistance dividing networks 326-331 in the ladder resistance 307 of drawing 3 , as an example, carries out resistance division by resistance 1R, and shows the configuration in the case of generating eight gradation electrical-potential-difference A-H for fine adjustment here. A selector circuit 701 chooses 1 gradation electrical potential difference with the set point 703 of the fine adjustment register 306 among each gradation electrical-potential-difference A-H for fine adjustment generated in this resistance dividing network 702.

[0051] The above-mentioned selector circuit 701 consists of 2to(es)1 (2 input 1 output) selector circuits, chooses the 1st step of output of the selector circuit group 704 by [0] bit eye of the register set point 703, chooses the 2nd step of output of the selector circuit group 705 by [1] bit eye, and chooses the 3rd step of output of a selector circuit 706 by [2] bit eye.

[0052] When the register set point 703 sets up with "000 [BIN]" here, a selector circuit 701 outputs the gradation electrical potential difference A for fine adjustment by which the partial pressure was carried out in the resistance dividing network 702. Next, when the register set point 703 sets up with "111 [BIN]", a selector circuit 701 outputs the gradation electrical potential difference H for fine adjustment by which the partial pressure was carried out in the resistance dividing network 702. Thus, a selector circuit 701 chooses from A to H the gradation electrical potential difference for fine adjustment by which the partial pressure was carried out in the resistance dividing network 702 one by one, whenever the register set point 703 of the fine adjustment register 306 increases one time. The relation between this register set point 703 and gradation electrical-potential-difference A-H for fine adjustment chosen in a selector circuit 701 is shown in 707.

[0053] In addition, the relation of the register set point and the selector circuit which were shown above is an example of 1 setting out, and when each bit of the register set point is reversed, the relation between the above-mentioned register set point and a selector circuit becomes reverse, and if the register set point increases, a selector circuit will be chosen from the gradation electrical potential difference H for fine adjustment one by one to A. Thus, the case where relation between the register set point and a variable-resistance value is made into reverse is sufficient.

[0054] moreover, the above-mentioned selector circuit -- register setting-out bit -- although it is what sets a number to 3 bits and

chooses 1 gradation electrical potential difference from eight gradation electrical potential differences for fine adjustment -- this setting-out bit -- the increase of the number of gradation which can increase and choose a number -- you may carry out. In this case, although the fine adjustment range of a gradation electrical potential difference becomes large, circuit magnitude increases. Moreover, although the resistance inside a resistance dividing network is set to 1R, this value may be made small, or you may enlarge. When the resistance inside this resistance dividing network is made small, although the fine adjustment range becomes narrow, adjustment precision improves. Moreover, when the resistance inside a resistance dividing network is enlarged, although the fine adjustment range becomes large, adjustment precision gets worse. Moreover, it is desirable to constitute the unit resistance R from several 10komega as well as the variable-resistance configuration of drawing 4 (the consumed electric current can be lessened).

[0055] Next, an adjustment operation of the gamma property by the fine adjustment register 306 and selector circuits 308-313 of drawing 3 is explained using drawing 8 .

[0056] In drawing 8 , 801 is the gradation number-gradation voltage characteristic when the fine adjustment register 306 considers as default setting. Moreover, 802 is property drawing at the time of setting up the set point of the fine adjustment register 306 so that the electrical-potential-difference value chosen in selector circuits 308-313 may serve as max. 803 is property drawing at the time of setting up the set point of the fine adjustment register 306 so that the electrical-potential-difference value chosen in selector circuits 308-313 may serve as min. Therefore, the electrical potential difference between the above 802 and 803 is the gradation electrical-potential-difference range which can be set up with the fine adjustment register 306 and which can be tuned finely. 804-809 show the output (gradation electrical potential difference which can be tuned finely) of selector circuits 308-313, and can tune it finely here by gradation electrical-potential-difference within the limits between the above 802 and 803, respectively.

[0057] As mentioned above, by setting out of the fine adjustment register 306 of drawing 3 , 1 gradation electrical potential difference is chosen from each gradation electrical potential difference for fine adjustment generated in the resistance dividing networks 326-331 in the ladder resistance 307, and fine adjustment is made possible. Fine adjustment of the gradation electrical potential difference doubled with the property of liquid crystal panel each is enabled by this, and high

definition-ization can be desired by improving adjustment precision.
[0058] The example of a liquid crystal display system configuration at the time of incorporating the gradation electrical-potential-difference generation circuit which can adjust a gamma property in a signal-line actuation circuit using the amplitude explained by ****, an inclination, and three kinds of adjustment registers of fine adjustment is shown in drawing 9 . 900 in drawing is the liquid crystal display of this invention here, 901 is a liquid crystal panel, 902 is a signal-line actuation circuit including the gradation electrical-potential-difference generation circuit 302 of drawing 3 which outputs the gradation electrical potential difference corresponding to an indicative data to the signal line of a liquid crystal panel 901, 903 is a scanning-line actuation circuit which scans the scan line of a liquid crystal panel 901, and 904 is a system power generation circuit which supplies the power source of the above-mentioned signal-line actuation circuit 902 and the scanning-line actuation circuit 903 of operation. Here, the reference voltage 316 of drawing 3 is contained in the supply voltage 905 supplied to the signal-line actuation circuit 902 from this system power generation circuit 904. Next, 906 is MPU (microprocessor unit) which performs the various control and the various processings for displaying an image on a liquid crystal panel 901, and the signal-line actuation circuit 902 consists of the control register 301 and the gradation electrical-potential-difference generation circuit 302 which were shown by the display memory 909 for saving the indicative data 908 outputted from the system interface 907 which exchanges the data of a control register in an indicative-data list with this MPU906, and a system interface 907 temporarily, and drawing 3 , and a decoding circuit 303. In addition, the control register 301 interior contains the amplitude adjustment register 304 shown also by drawing 3 , the inclination adjustment register 305, and the fine adjustment register 306.
[0059] The above MPU 906 is based on the bus interface of 16 bits of 68 systems which are general-purpose MPU. CS (chip Select) signal which shows a chip select, RS (Register Select) signal which chooses whether data are specified for whether the address of a control register 301 is specified, It consists of 16-bit Data signals which are the address of the R/W (Read/Write) signal which chooses the writing or read-out of E (Enable) signal and data which directs starting of processing actuation, and a control register 301, or the actual set point of data. by these control signals, the register set point of the amplitude adjustment register 304, the inclination adjustment register 305, and the fine

adjustment register 306 is assigned to each address of a control register 301, and it operates by writing in setting-out data the whole quota **** address, or carrying out reading appearance into the register of a control register 301.

[0060] Next, drawing 10 is used and actuation of each control signal during the interface 907 of the this MPU906 and signal-line actuation circuit 902 interior is explained. First, CS signal is made into a "low" and a control register 301 is made into an accessible condition. At the time of a "low", an addressing period is meant for RS signal, and a data specification period is meant at the time of RS signal "yes." When performing write-in actuation to a control register 301 here, a R/W signal is made into a "low", a predetermined address value is set as a Data signal at a previous addressing period, and the data (**, such as the register set point of the above-mentioned amplitude adjustment register 304, the inclination adjustment register 305, and the fine adjustment register 306) written in the register of the address at a data specification period are set up. Data are written in a control register 301 by making the E signal after setting out into a fixed period "yes."

[0061] Moreover, in case the data set as the control register 301 are read, CS and RS signal are set up like the above, a R/W signal is carried out to "yes", the predetermined address is set as an address period, and reading appearance of the data written in in the register is carried out to a data specification period like the above by making E signal after setting out into a fixed period "yes."

[0062] as mentioned above, the register set point of the amplitude adjustment register 304, the inclination adjustment register 305, and the fine adjustment register 306 by performing write-in actuation to each quota **** address in the register of a control register 301 In adjustment of the gamma property mentioned above, setting out of the gradation electrical potential difference which the amplitude voltage adjustment of the gradation electrical potential difference by each above-mentioned register, inclination property adjustment of the halftone section, and fine adjustment were attained, and adjustment of a gamma property became easy, and was doubled with the property of liquid crystal panel each is enabled.

[0063] Next, the configuration of the liquid crystal display by the 2nd operation gestalt of this invention is explained.

[0064] First, when impressing a gradation electrical potential difference to a liquid crystal panel generally, a gradation electrical potential difference must be reversed with the AC signal (Following M is

called.) of a certain fixed period, and a liquid crystal panel must be alternating-current--ization-driven.

[0065] The gradation number-gradation voltage characteristics of a liquid crystal panel also differ the whole polarity of Above M, and have the case which must be adjusted to a desired gamma property for every polarity of the M here. Here shows change of the gradation number-gradation voltage characteristic in alternating-current-izing of a liquid crystal panel to drawing 11 . 1101 is the gradation number-gradation voltage characteristic at the time of straight polarity (the polarity of M is M= 0). The gradation electrical potential difference shows the property of becoming high as a gradation number becomes large, when a liquid crystal panel is in NOMA reeve rack mode here. 1102 is the gradation number-gradation voltage characteristic at the time of negative polarity (the polarity of M is M= 1). The gradation electrical potential difference shows the property of becoming low as a gradation number becomes large here. 1101 and 1102 have relation of the symmetry centering on the center line 1103 here. Thus, if straight polarity or the gradation number-gradation voltage characteristic of negative polarity is the relation of the symmetry In the gradation electrical-potential-difference generation circuitry of drawing 3 by the 1st above mentioned operation gestalt If output relation of 64 gradation electrical potential differences is reversed (the gradation electrical potential difference of 64 gradation eye is made into the gradation electrical potential difference of 1 gradation eye, and the relation between the gradation electrical potential difference of 64 gradation eye, a gradation electrical potential difference, and a gradation number is reversed for the gradation electrical potential difference of 1 gradation eye), there will be no need of adjusting a gamma property in forward / negative amphipathy. However, there is a case used as the gradation number-gradation voltage characteristic which is different by forward/negative polarity like 1104 depending on a liquid crystal panel. In this case, in the gradation electrical-potential-difference generation circuitry by the 1st operation gestalt of drawing 3 , in order to adjust to a desired gamma property, according to the property of forward/negative polarity, register setting out must be performed at any time. Then, in order to solve the above-mentioned problem, with the operation gestalt of **** 2, the ladder resistance with the same operation as the 1st operation gestalt was independently provided in the object for straight polarity, and negative polarity, and it considered as the configuration which can adjust a gamma property by forward / negative amphipathy.

[0066] The configuration of the liquid crystal display by the 2nd operation gestalt of this invention is explained using drawing 12 .
[0067] Drawing 12 changes only the internal configuration of the gradation electrical-potential-difference generation circuit 302 of drawing 3 in said 1st operation gestalt. In addition, about the configuration and actuation of a control register 301 or the decoding circuit 303, it is the same as that of the 1st operation gestalt. The gradation electrical-potential-difference generation circuit 302 of drawing 12 is considering ladder resistance 307 of drawing 3 in the 1st operation gestalt as the ladder resistance 1202 for straight polarity and the ladder resistance 1203 for negative polarity, and the configuration independently provided two for every forward / negative polarity here.
[0068] In addition, these forward / ladder resistance 1202 and 1203 for negative polarity are taken as the configuration which can perform the same operation as the 1st operation gestalt by register setting out of the amplitude adjustment register 304 and the inclination adjustment register 305.
[0069] Here, these forward / ladder resistance 1202 and 1203 for negative amphipathy share the set point of the above-mentioned adjustment registers 304 and 305, and are taken as the configuration which can perform adjustment of the amplitude electrical potential difference of a gradation electrical potential difference, and adjustment of a property inclination for every forward / negative polarity like the 1st operation gestalt with that set point. Here, resistance setting out of the ladder resistance 1202 interior for straight polarity and ladder resistance 1203 internal-resistance value setting out for negative polarity are considered as resistance setting out which is different so that gradation voltage adjustment which is different by this setting out of the above-mentioned adjustment registers 304 and 305 with straight polarity and negative polarity can be performed.
[0070] Moreover, the selector circuits 308-313 in drawing 3 also become required [the selector circuit 1204 for straight polarity and the selector circuit 1205 for negative polarity] two classes by providing-two forward / ladder resistance 1202 and 1203 for negative polarity as mentioned above. Here, forward / selector circuits 1204 and 1205 for negative amphipathy are considered as the selector circuits 308-313 and this configuration of drawing 3 which are the 1st operation gestalt, and enable fine adjustment of the 1st operation gestalt and this operation by fine adjustment register 306 setting out.

[0071] It considers as the above configurations and forward / ladder resistance 1202 and 1203 for negative polarity and forward / selector circuit for negative polarity 1204, and 1205 outputs are chosen with the polarity of M by the polar selector circuits 1201 and 1206 chosen by M signal. In addition, the above-mentioned polar selectors 1201 and 1206 will choose the ladder resistance 1202 for straight polarity, and selector circuit 1204 output for straight polarity in M= 0:00, and will choose the ladder resistance 1203 for negative polarity, and selector circuit 1205 output for negative polarity in M= 1:00.
[0072] It considered as the above gradation electrical-potential-difference generation circuitry, and the liquid crystal display which can adjust the gamma property of forward / negative amphipathy independently by including in the same liquid crystal display system as drawing 9 in the 1st operation gestalt was realized. In addition, suppose the set point of each adjustment registers 304-306 that it assigns the address in a control register 301, respectively, and write-in actuation of each register set point is performed with the control signal of drawing 10 like the 1st operation gestalt.
[0073] Next, the gradation electrical-potential-difference generation circuitry by the 3rd operation gestalt is shown in drawing 13 . This operation gestalt considers ladder resistance which was being considered as 2 configurations with the operation gestalt above-mentioned [2nd] as 1 configuration, forward / negative polarity independence is achieved, and it possesses each adjustment registers, such as amplitude in the 1st operation gestalt, an inclination, and a fine adjustment register, and enables it to adjust the gamma property of forward / negative amphipathy independently here. Drawing 13 changes only the internal configuration of a control register 301 here in the gradation electrical-potential-difference generation circuit which is the 1st operation gestalt of drawing 3 . Therefore, about the configuration and actuation of the gradation generation circuit 302, the decoding circuit 303, etc., it is the same as that of the operation gestalt of the above-mentioned 1st. About the interior of the control register 301 of drawing 13 , 1301 shall be a fine adjustment register for negative polarity, and the amplitude adjustment register for straight polarity and 1302 shall set [the amplitude adjustment register for negative polarity, and 1303 / the inclination adjustment register for straight polarity, and 1304 / the inclination adjustment register for negative polarity, and 1305] up independently the fine adjustment register for straight polarity, and 1306 by forward / negative amphipathy here, respectively. By the selector circuits 1307-1309 chosen with M signal, these adjustment

registers 1301-1306 choose the set point of the registers 1301-1306 according to forward/negative polarity. These selector circuits 1307-1309 will choose the set point of the registers 1301, 1303, and 1305 for straight polarity in M= 0:00, and will choose the set point of the registers 1302, 1304, and 1306 for negative polarity here in M= 1:00, respectively. An operation equivalent to the fine adjustment register in which the operation equivalent to the inclination adjustment register in which the operation equivalent to the amplitude adjustment register by the 1st operation gestalt which showed forward / amplitude adjustment registers 1301 and 1302 for negative polarity by drawing 5 was acquired, and forward / inclination adjustment registers 1303 and 1304 for negative polarity were shown by drawing 6 was acquired, and forward / fine adjustment registers 1305 and 1306 for negative polarity were shown by drawing 8 here is acquired.

[0074] Therefore, forward / negative amphipathy considered adjustment of the gradation electrical potential difference suitable for the property of liquid crystal panel each, and a gamma property as the configuration which can be adjusted independently by acquiring an operation like the 1st operation gestalt in forward/negative polarity with forward / adjustment registers 1301-1306 for negative polarity which were mentioned above.

[0075] The liquid crystal display which can adjust the gamma property of forward / negative amphipathy independently on a scale of [gestalt / 2nd / operation] a small circuit by including the control register 301 above configurations in the liquid crystal display system of drawing 14 was realized. In addition, suppose the set point of forward / adjustment registers 1301-1306 for negative polarity that forward / adjustment registers 1301-1306 for negative polarity are assigned to the address in a control register 301, respectively, and write-in actuation of each register set point is performed with the same control signal as drawing 10 .

[0076] Next, the configuration of the liquid crystal display by the 4th operation gestalt of this invention is explained.

[0077] A liquid crystal panel also has the case where apply a back light, may display an image by that activity application, and the gradation number-gradation voltage characteristic of a liquid crystal panel changes with these back lights ON and OFF in this case, and also needs to perform adjustment of a gamma property. This operation gestalt explains the adjustment approach of the gamma property at the time of the above back light ON/OFF using drawing 15 .

[0078] In liquid crystal display system configuration drawing in the 1st

operation gestalt of drawing 9 , drawing 15 changes the control register 301 interior in MPU906 and the signal-line actuation circuit 902, and is the same as that of the 1st operation gestalt about the configuration of other blocks, and actuation. However, a liquid crystal panel 901 shall include an above-mentioned back light circuit. Here, a back light ON/OFF distinction means 1401 to distinguish the above-mentioned back light ON/OFF is formed in the MPU906 interior, and a register 1403 is independently provided at the time of the back light OFF containing the register 1402 and this above-mentioned register at the time of the back light ON containing the amplitude adjustment register 304 which has the same operation as said 1st operation gestalt in a control register 301, the inclination adjustment register 305, and the fine adjustment register 305. The register set point which chose the set point of a register 1403 in the selector circuit 1405 at the time of a register 1402 and a back light OFF at the time of the above-mentioned back light ON, and was chosen in this selector circuit 1405 by the distinction signal 1404 which shows the back light ON outputted from the previous back light ON/OFF distinction means 1401 here or a back light-off condition is used in the gradation electrical-potential-difference generation circuit 302 which is the 1st operation gestalt and this configuration.

[0079] By considering the amplitude which has the same operation as the 1st operation gestalt in a control register 301 as mentioned above, an inclination, and a fine adjustment register as the configuration which possesses two kinds in a ** at the time of a back light ON and a back light OFF, also with adjustment of the gamma property in the property of liquid crystal panel each by back light ON/OFF, it could adjust according to the individual and the liquid crystal display which can desire high definition-ization was realized. In addition, suppose the set point of a register 1403 that it assigns the address in a control register 301, respectively, and write-in actuation of each register set point is performed with the control signal of drawing 10 like the 1st operation gestalt at the time of the register 1402 at the time of a back light ON, and a back light OFF.

[0080] Next, the configuration of the liquid crystal display by the 5th operation gestalt of this invention is explained.

[0081] This operation gestalt enables it to adjust a gamma property according to an individual to every red who is the foreground color of a liquid crystal panel, green, and blue (for Following R, G, and B to be called.), and explains it using drawing 16 about the configuration.

[0082] Like drawing 15 of the 4th operation gestalt, in liquid crystal

display system configuration drawing in the 1st operation gestalt of drawing 9 , drawing 16 changes only the internal configuration of a control register 301, and is the same as that of the 1st operation gestalt about the configuration of other blocks, and actuation. In order to adjust the gamma property of Above R, G, and B according to an individual here, it considered as the configuration which possesses independently the adjustment register 1601 for R, the adjustment register 1602 for G, and the adjustment register 1603 for B in a control register 301. The above-mentioned adjustment registers 1601-1602 all contain the amplitude adjustment register 304 with which the same operation as the 1st operation gestalt is acquired, the inclination adjustment register 305, and the fine adjustment register 306 here. As mentioned above, by considering as the configuration which carries out register possession independently for every foreground color of liquid crystal panels, such as an object containing the amplitude which has the same operation as the 1st operation gestalt in a control register 301, an inclination, and a fine adjustment register for R, an object for G, and the adjustment registers 1601-1603 for B, adjustment of the foreground colors R and G of a liquid crystal panel and the gamma property of B each color was enabled [that it is individual and], and the liquid crystal display which can desire high definition-ization more was realized. In addition, suppose the set point of the object for R, the object for G, and the adjustment registers 1601-1603 for B that it assigns the address in a control register 301, respectively, and write-in actuation of each register set point is performed with the control signal of drawing 10 like the 1st operation gestalt.

[0083] There is no this invention and various modification is possible for it what is limited to the operation gestalt shown above. For example, in ****, although the mode of a liquid crystal panel was explained on the assumption that NOMA reeve rack mode, this invention can be carried out regardless of the mode of the above-mentioned liquid crystal panel. Moreover, although the number of gradation was explained on the assumption that 64 gradation, this invention can be carried out regardless of the number of other gradation.

[0084] the 1- of above-mentioned this invention -- an amplitude adjustment register and an inclination adjustment register provide, adjustment of a gamma property makes easy and, according to the 5th operation gestalt, adjustment time amount can shorten by the register setting out in adjustment of a gamma property by providing the ladder resistance configuration which can adjust the amplitude electrical potential difference of the gradation electrical potential difference

according to the property of liquid-crystal-panel each, and a rough gradation electrical potential difference called the inclination property of the halftone section. Moreover, there are small circuit magnitude and effectiveness of low cost by the thing which can perform each above-mentioned adjustment by ladder resistance and for which things are done.

[0085] Moreover, by considering as the configuration which can tune finely further by providing a fine adjustment register to the gradation electrical potential difference adjusted with the above-mentioned register in addition to an amplitude register and an inclination register, adjustment precision is raised and there is effectiveness which can desire high definition-ization.

[0086] moreover, the 1- of above-mentioned this invention -- since adjustment of the gamma property doubled with the property of liquid crystal panel each is attained according to the 5th operation gestalt, it is effective in the ability to build flexible circuitry.

[0087]

[Effect of the Invention] According to this invention, the adjustment precision of the gamma property of a liquid crystal display improves, and this does so the effectiveness of improving image quality.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Gamma property drawing of a typical liquid crystal panel

[Drawing 2] The content of adjustment of the gamma property of this invention

[Drawing 3] Gradation electrical-potential-difference generation circuitry drawing by the 1st operation gestalt of this invention

[Drawing 4] The variable-resistance block diagram used for the operation gestalt of this invention
[Drawing 5] An adjustment operation of the gamma property by amplitude adjustment register setting out of this invention
[Drawing 6] An adjustment operation of the gamma property by inclination adjustment register setting out of this invention
[Drawing 7] The selector circuit block diagram used for the operation gestalt of this invention
[Drawing 8] An adjustment operation of the gamma property by fine adjustment register setting out of this invention
[Drawing 9] System configuration drawing of the liquid crystal display by the 1st operation gestalt of this invention
[Drawing 10] Register setting-out flow drawing of this invention
[Drawing 11] Unsymmetrical gamma property drawing of a liquid crystal panel
[Drawing 12] Gradation electrical-potential-difference generation circuitry drawing by the 2nd operation gestalt of this invention
[Drawing 13] Gradation electrical-potential-difference generation circuitry drawing by the 3rd operation gestalt of this invention
[Drawing 14] System configuration drawing of the liquid crystal display by the 3rd operation gestalt of this invention
[Drawing 15] System configuration drawing of the liquid crystal display by the 4th operation gestalt of this invention
[Drawing 16] System configuration drawing of the liquid crystal display by the 5th operation gestalt of this invention
[Drawing 17] The gamma equalization circuit schematic diagram of the conventional technique
[Description of Notations]
301 -- A control register, 302 -- A gradation electrical-potential-difference generation circuit, 303 -- Decoding circuit, 304 -- An amplitude adjustment register, 305 -- An inclination adjustment register, 306 -- Fine adjustment register, 307 -- Ladder resistance, 308-313 -- A selector circuit, 314 -- Amplifier circuit, 315 -- Output section ladder resistance, 316 -- Reference voltage, 317 -- Bottom variable-resistance set point, 318 -- The upside variable-resistance set point, 319 -- Pars intermedia bottom variable-resistance set point, 320 [-- Pars intermedia bottom variable resistance, 324 / -- Pars intermedia upside variable resistance, 325 / -- The fine adjustment register set point, 326-331 / -- Resistance dividing network.] -- The pars intermedia upside variable-resistance set point, 321 -- Bottom variable resistance, 322 -- Upside variable resistance, 323

[Translation done.]

* NOTICES *

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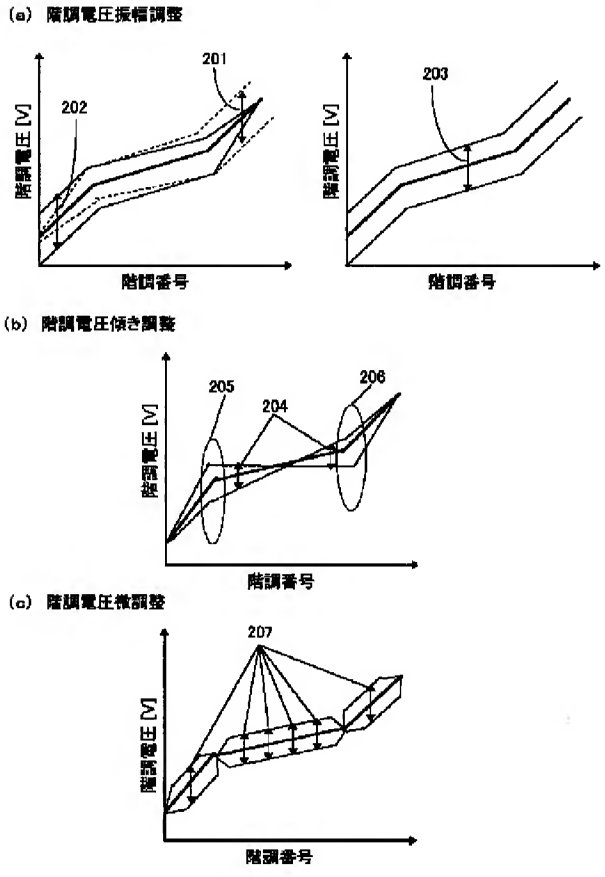
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

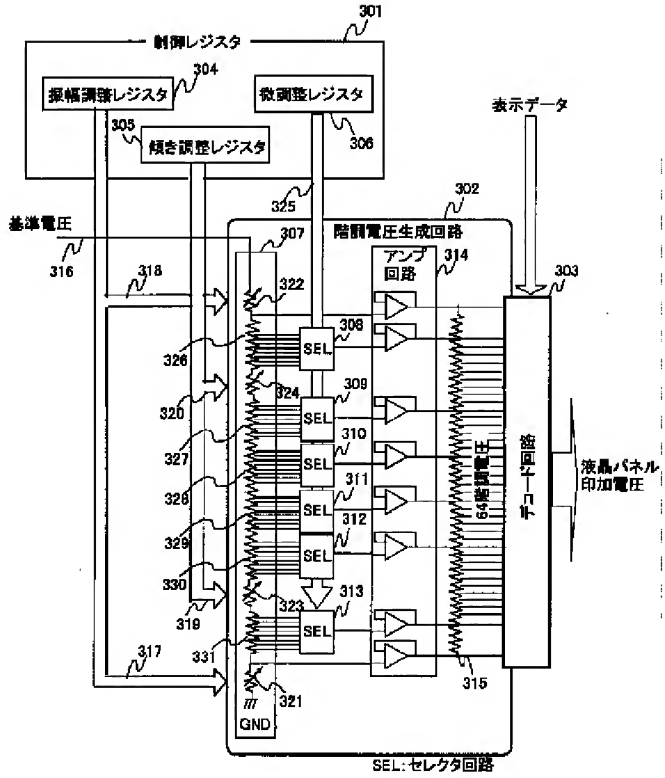
[Drawing 2]

図2



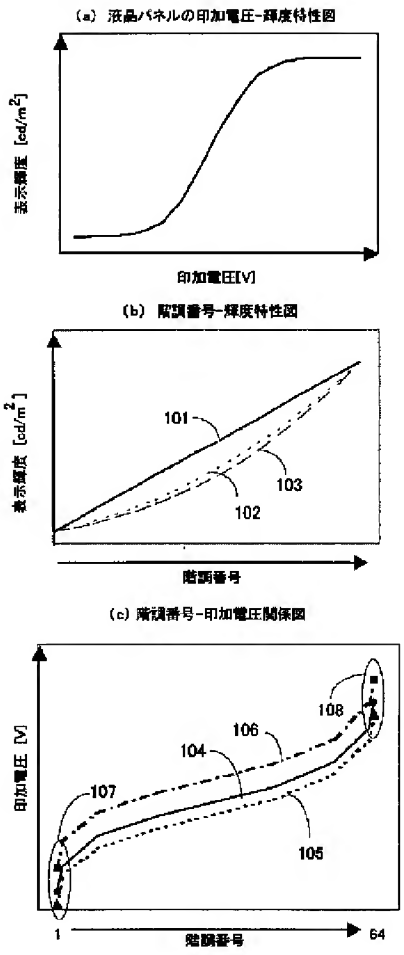
[Drawing 3]

図3


301
制御レジスタ
304
振幅調整レジスタ
305
傾き調整レジスタ
306
微調整レジスタ
表示データ
325
302
基準電圧
316
307
階調電圧生成回路
アンプ回路
314
303
318
322
308
326
324
309
320
SEL
310
327
311
328
312
329
313
330
323
319
317
331
321
GND
315
出力電圧64階調
液晶パネル印加電圧
SEL:セレクタ回路

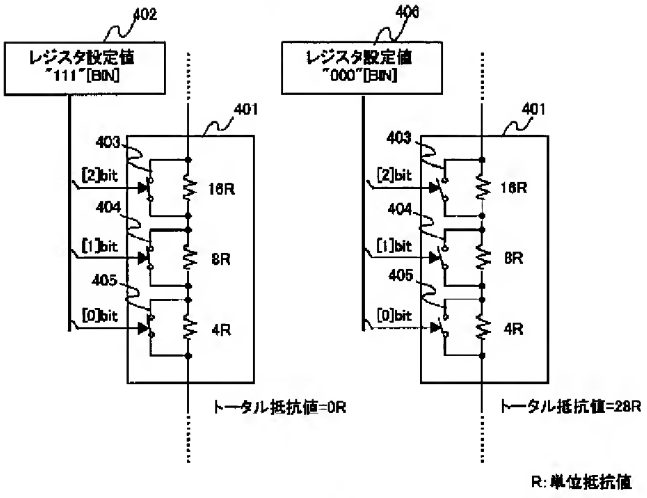
[Drawing 1]

図1


(a) 液晶パネルの印加電圧-輝度特性図
表示輝度 [cd/m2]
印加電圧[V]
(b) 階調番号-輝度特性図
表示輝度 [cd/m2]
101
102
103
階調番号
(c) 階調番号-印加電圧関係図
印加電圧 [V]
104
105
106
107
108
1
64
階調番号

[Drawing 4]

図4

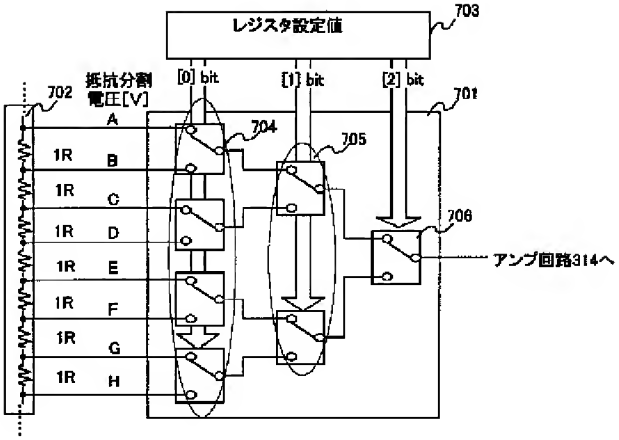


407

レジスタ設定値[BIN]	可変抵抗値
111	0R
110	4R
101	8R
100	12R
011	16R
010	20R
001	24R
000	28R

[Drawing 7]

図7

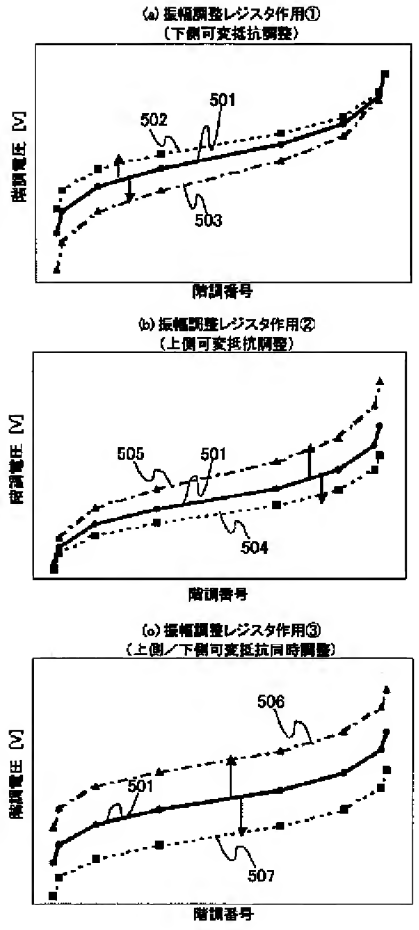


707

レジスタ設定値[BIN]	抵抗分割電圧[V]
111	H
110	G
101	F
100	E
011	D
010	C
001	B
000	A

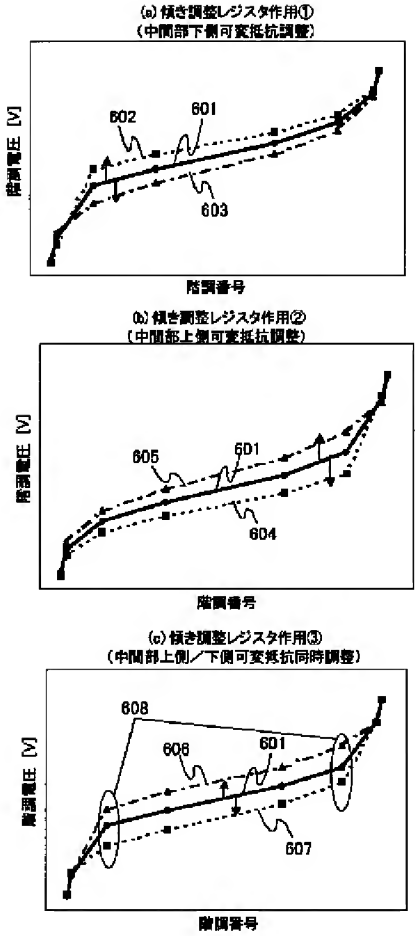
[Drawing 5]

図5


(a) 振幅調整レジスタ作用①
(下側可変抵抗調整)
501
502
503
階調電圧 [V]
階調番号
(b) 振幅調整レジスタ作用②
(上側可変抵抗調整)
505
501
504
階調電圧 [V]
階調番号
(c) 振幅調整レジスタ作用③
(上側／下側可変抵抗同時調整)
506
501
507
階調電圧 [V]
階調番号

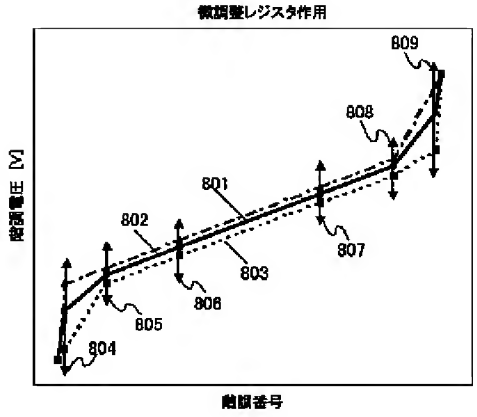
[Drawing 6]

図6



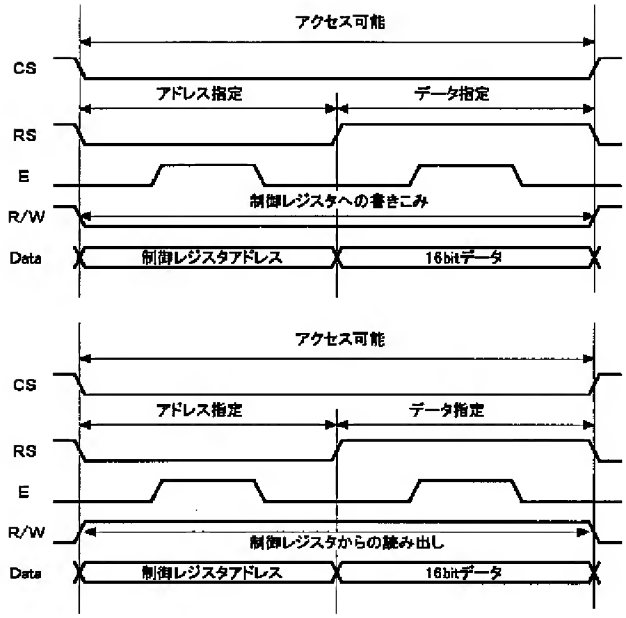
[Drawing 8]

図8



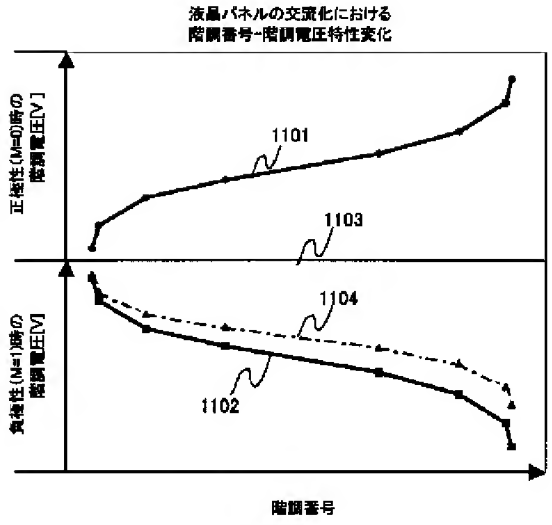
[Drawing 10]

図10



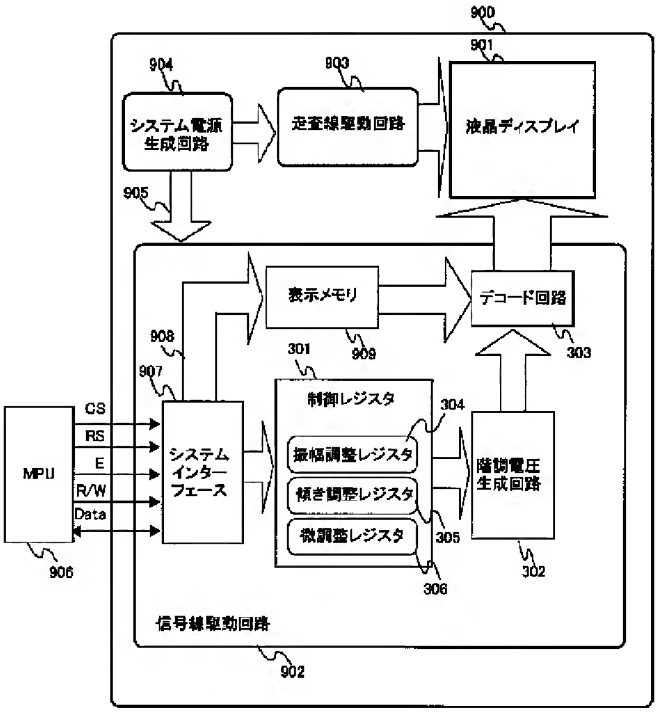
[Drawing 11]

図11



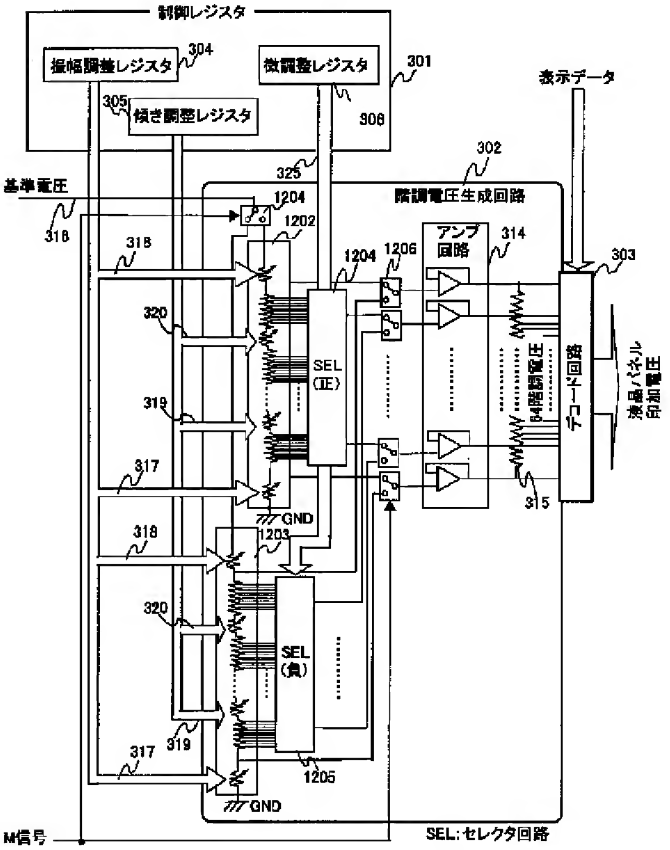
[Drawing 9]

図9



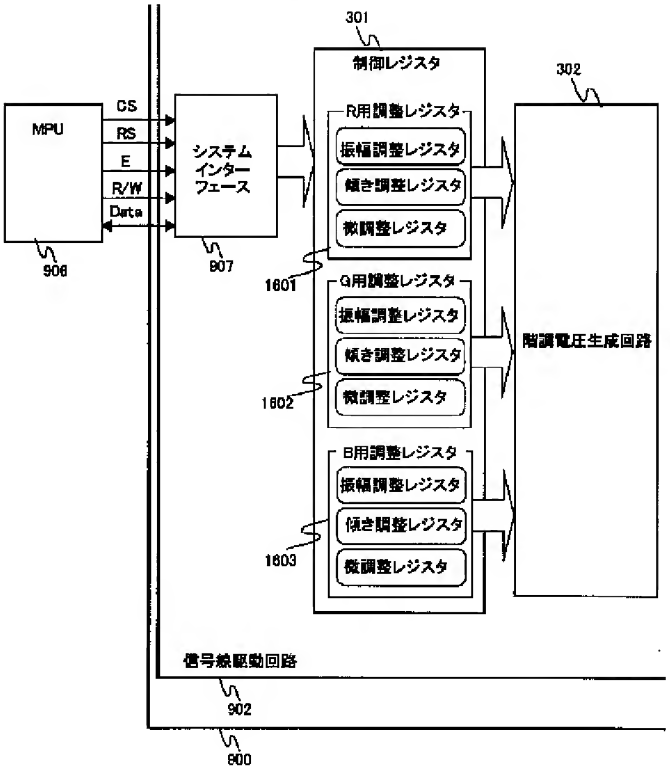
[Drawing 12]

図12



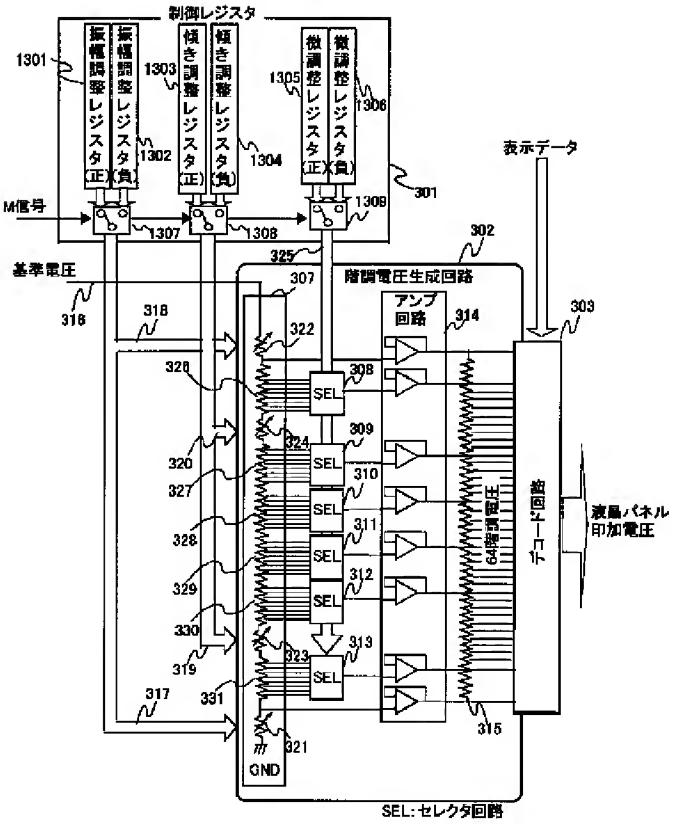
[Drawing 16]

図16



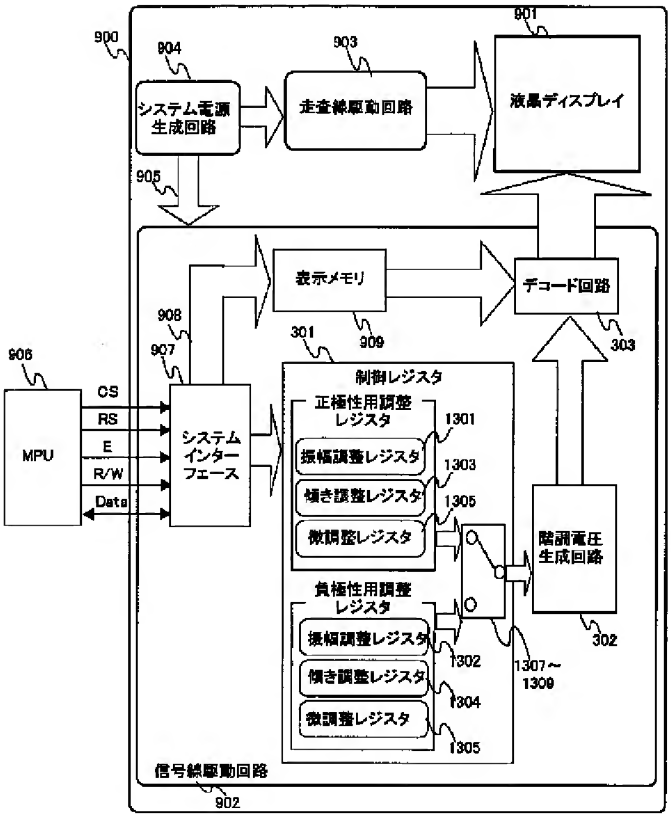
[Drawing 13]

図13



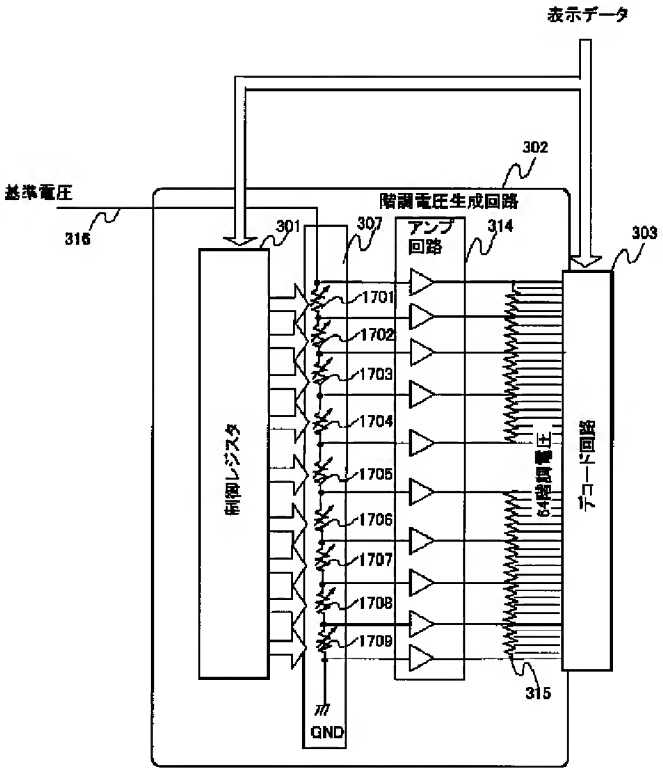
[Drawing 14]

図14



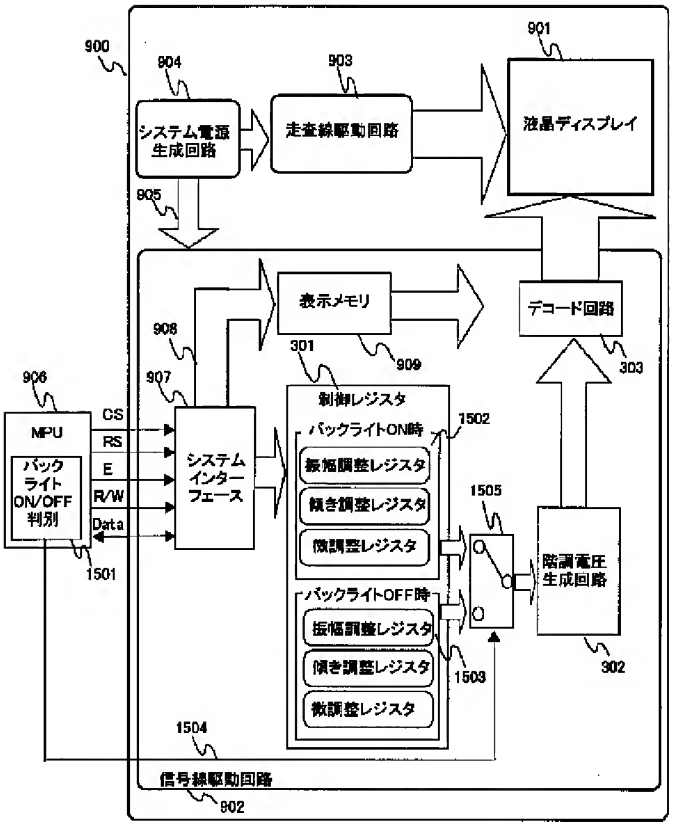
[Drawing 17]

図17



[Drawing 15]

図15



[Translation done.]

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Ｇ０９Ｇ　3/20	６１２	Ｃ０９Ｇ　3/20	６１２Ｆ	５Ｃ０５８
	６３１		６３１Ｕ	５Ｃ０８０
	６４１		６４１Ｃ	

審査請求　未請求　請求項の数13　ＯＬ　（全 16 頁）　最終頁に続く

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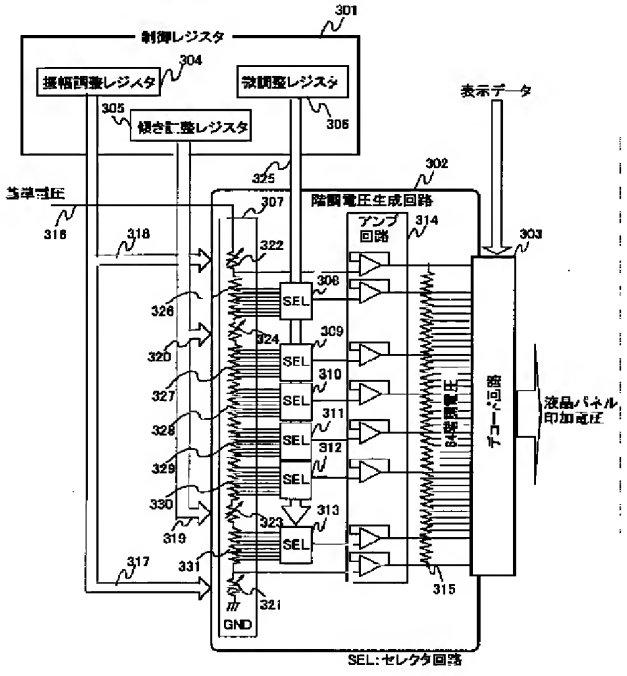
最終頁に続く

(54)【発明の名称】　液晶駆動装置及び液晶表示装置

(57)【要約】
【課題】本発明は、ガンマ特性の調整において、振幅、傾き、微調整といった３種類の調整により、液晶パネル個々の特性に応じたガンマ特性を最適かつ容易に調整可能とし、高画質化及び汎用性を実現する。
【解決手段】本発明は、基準電圧を抵抗分割する複数のラダー抵抗326～330と、ラダー抵抗によって定刻分割された電圧を抵抗分割する抵抗分割回路と、表示データに応じて、定刻分割回路によって抵抗分割された電圧から、階調電圧を選択するセレクタ回路308～313と、ラダー抵抗と基準電圧との間に位置する第１の可変抵抗322と、ラダー抵抗とグランドとの間に位置する第２の可変抵抗321と、複数のラダー抵抗間に位置する第３の可変抵抗323,324とを備える。

図3



【特許請求の範囲】
【請求項１】表示データに応じた階調電圧を生成し、液晶パネルへ出力する液晶駆動装置において、
基準電圧を抵抗分割するラダー抵抗と、
表示データに応じて、前記ラダー抵抗によって抵抗分割された電圧から、前記階調電圧を選択するセレクタ回路と、
前記ラダー抵抗と前記基準電圧との間に位置する可変抵抗とを備えた液晶駆動装置。
【請求項２】前記可変抵抗の抵抗値を調整するための調整レジスタを備えた請求項１に記載の液晶駆動装置。
【請求項３】前記調整レジスタは、階調番号と階調電圧との関係のグラフ上の振幅が設定される請求項２に記載の液晶駆動装置。
【請求項４】表示データに応じた階調電圧を生成し、液晶パネルへ出力する液晶駆動装置において、
基準電圧を抵抗分割するラダー抵抗と、
表示データに応じて、前記ラダー抵抗によって抵抗分割された電圧から、前記階調電圧を選択するセレクタ回路と、
前記ラダー抵抗とグランドとの間に位置する可変抵抗とを備えた液晶駆動装置。
【請求項５】前記可変抵抗の抵抗値を調整するための調整レジスタを備えた請求項４に記載の液晶駆動装置。
【請求項６】前記調整レジスタは、階調番号と階調電圧との関係のグラフ上の振幅が設定される請求項５に記載の液晶駆動装置。
【請求項７】表示データに応じた階調電圧を生成し、液晶パネルへ出力する液晶駆動装置において、
基準電圧を抵抗分割する複数のラダー抵抗と、
表示データに応じて、前記ラダー抵抗によって抵抗分割された電圧から、前記階調電圧を選択するセレクタ回路と、
前記複数のラダー抵抗間に位置する可変抵抗とを備えた液晶駆動装置。
【請求項８】前記可変抵抗の抵抗値を調整するための調整レジスタを備えた請求項７に記載の液晶駆動装置。
【請求項９】前記調整レジスタは、階調番号と階調電圧との関係のグラフ上の傾きが設定される請求項８に記載の液晶駆動装置。
【請求項１０】表示データに応じた階調電圧を生成し、液晶パネルへ出力する液晶駆動装置において、
基準電圧を抵抗分割するラダー抵抗と、
前記ラダー抵抗によって定刻分割された電圧を、抵抗分割する抵抗分割回路と、
表示データに応じて、前記定刻分割回路によって抵抗分割された電圧から、前記階調電圧を選択するセレクタ回路とを備えた液晶駆動装置。
【請求項１１】前記抵抗分割回路を調整するための調整レジスタを備えた請求項１０に記載の液晶駆動装置。
【請求項１２】表示データに応じた階調電圧を生成し、液晶パネルへ出力する液晶駆動装置において、
基準電圧を抵抗分割する複数のラダー抵抗と、
前記ラダー抵抗によって定刻分割された電圧を、抵抗分割する抵抗分割回路と、
表示データに応じて、前記定刻分割回路によって抵抗分割された電圧から、前記階調電圧を選択するセレクタ回路と、
前記ラダー抵抗と前記基準電圧との間に位置する第１の可変抵抗と、
前記ラダー抵抗とグランドとの間に位置する第２の可変抵抗と、
前記複数のラダー抵抗間に位置する第３の可変抵抗とを備えた液晶駆動装置。
【請求項１３】液晶パネルと、表示データに応じて前記液晶パネルへ階調電圧を出力する液晶駆動回路と、前記階調電圧を出力する前記液晶パネル上の走査ラインを駆動する走査線駆動回路とを備えた液晶表示装置において、
前記液晶駆動回路は、
基準電圧を抵抗分割する複数のラダー抵抗と、
前記ラダー抵抗によって定刻分割された電圧を、抵抗分割する抵抗分割回路と、
表示データに応じて、前記定刻分割回路によって抵抗分割された電圧から、前記階調電圧を選択するセレクタ回路と、
前記ラダー抵抗と前記基準電圧との間に位置する第１の可変抵抗と、
前記ラダー抵抗とグランドとの間に位置する第２の可変抵抗と、
前記複数のラダー抵抗間に位置する第３の可変抵抗とを備えた液晶表示装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、表示データに応じた階調電圧を生成し、液晶パネルへ出力する液晶駆動装置及びその液晶駆動装置を備えた液晶表示装置に係り、特に、ガンマ特性の調整が可能な液晶駆動装置及びその液晶駆動装置を備えた液晶表示装置に関する。
【０００２】
【従来の技術】まず液晶パネルに表示データを高画質で表示させるためには液晶パネル個々の特性に応じて所望のガンマ特性を調整する必要がある。従来技術においてもこのガンマ特性を調整可能な液晶表示装置が開示されている。
【０００３】まず一般的なガンマ特性について、図１を用いて説明する。図１において（ａ）は、液晶パネルのモードがノーマリーブラックモードである場合の印加電圧－輝度特性を示したものであり、低い印加電圧では低輝度、高い印加電圧では高輝度となる。特徴としては、

低い印加電圧領域と高い印加電圧領域では印加電圧に対する輝度変化が鈍い（飽和）状態となることが挙げられる。

【０００４】また上記ノーマリーブラックモードの液晶パネルの他にもノーマリーホワイトモードの液晶パネルがあるが、以下ノーマリーブラックモードの液晶パネルを対象とし、説明を行う。尚、本発明では上記液晶パネルのモードに関係なく実施できる。

【０００５】次に図１（ｂ）は階調番号－輝度特性を示したものである。通常、この特性をガンマ特性と称されている。ここで、図１（ｂ）の１０１は階調番号の増加に対し、輝度がリニアに上昇する特性を示しており、この特性をγ＝１．０の特性と呼ぶ。ここでこのγ値は、下記（１）式の関係式により成り立つ。

【０００６】

（階調番号）$^{\gamma}$＝輝度［ｃｄ／ｍ^{2}］・・・（１）

上記（１）式より、図１（ｂ）の１０２、１０３はそれぞれγ＝２．２、γ＝３．０の特性を示したものである。ここで従来、液晶パネルに表示データを表示させた場合、その表示画像が人の目で最も高画質であると感じる特性は、一般に上記１０２のγ＝２．２の時である。

【０００７】ここで液晶表示装置では、階調番号毎に印加電圧を調整することで、上記ガンマ特性の調整を行っている。図１（ｃ）は上記した階調番号－印加電圧の関係図であり、階調数を６４階調とした場合である。ここで図１で示した印加電圧－輝度特性は液晶パネル個々において異なり、例とし、上記γ＝２．２に印加電圧を合わせた場合、液晶パネル個々でその印加電圧の調整値は異なってくる。図１（ｃ）の１０４は上記γ＝２．２とした場合の階調番号－印加電圧の関係図である。１０５、１０６はそれぞれ１０４と異なった液晶パネルにおいて、γ＝２．２とした場合の階調番号－印加電圧の関係図である。このように液晶表示装置内にはこの印加電圧（以下、階調電圧と称す。）を液晶パネル個々の特性に合わせて所望のガンマ特性に調整できるような階調電圧生成回路が必要となる。

【０００８】次に上述したガンマ特性の調整が可能な液晶表示装置の一例として、特開２００１－１８１１０２号「液晶表示装置用ソース・ドライバ及びそれを用いた液晶表示装置」がある。

【０００９】以下、図１７を用いて、上記従来例の動作について簡単に説明する。

【００１０】図１７において、３０２は階調電圧生成回路であり、この階調電圧生成回路はガンマ調整用制御レジスタ３０１、また１７０１～１７０９の可変抵抗によって構成されるラダー抵抗３０７、アンプ回路３１４、出力部ラダー抵抗３１５で構成されている。また３０３は階調電圧生成回路３０２で生成された階調電圧から表示データに応じた階調電圧をデコードするデコード回路である。ここで階調電圧生成回路３０２は、表示データに含まれた抵抗値設定データをガンマ補正用制御レジスタ３０１で検出し、その検出した抵抗値設定データにより、ラダー抵抗３０７の可変抵抗１７０１～１７０９の抵抗値を設定する。ここでこのラダー抵抗３０７は、外部から供給される基準電圧３１６とＧＮＤ間を先のガンマ補正用制御レジスタ３０１で抵抗値設定された可変抵抗１７０１～１７０９により抵抗分割し、６４階調電圧のうち１０点の階調電圧を生成する。このラダー抵抗３０７で生成された１０点の階調電圧は、後段のアンプ回路３１４でバッファリングされ、出力部ラダー抵抗３１５で先の１０点の階調電圧をさらに抵抗分割し、所望の６４階調電圧を生成する。次にこの６４階調電圧を３０３のデコード回路で表示データに合った階調電圧を選択する。

【００１１】以上のように従来の技術は、液晶表示装置内に階調電圧生成回路３０２を具備し、この階調電圧生成回路３０２内部のラダー抵抗３０７を構成する９個の可変抵抗１７０１～１７０９の抵抗値をガンマ補正用制御レジスタ３０１で設定することで、その抵抗分割比を変えることにより、ラダー抵抗３０７の基準電圧３１６とＧＮＤ間から生成される各階調電圧を変化させ、液晶パネル個々の特性における所望のガンマ特性に応じて各階調電圧を調整するものであった。

【００１２】

【発明が解決しようとする課題】上記従来技術では、６４階調電圧のうち図１（ｃ）に示す１０７、１０８といった階調番号の両端の電圧を固定としており、それぞれＧＮＤ又は外部から供給される基準電圧３１６としていた。この場合、ＧＮＤ固定としている階調電圧は調整不可能であり、また基準電圧３１６固定としている階調電圧は、その調整を行う場合、階調電圧生成部３０２の外部に別調整回路が必要となり、部品数増となる。ここで図１（ｃ）の１０４、１０５、１０６の関係といったように、液晶パネルの特性の相違により、階調番号の両端の電圧を調整しなければならないケースは生じ、上記従来技術ではこれらのケースについては考慮されていなかった。

【００１３】上記問題を解決する手段として、特開平１１－１７５０２７号公報で記載されているアンプ回路３１４にオフセット調整（階調電圧の振幅電圧は一定とし、その特性をｙ軸方向にシフトさせる）機能を持たせ、階調番号の両端の電圧を調整する手段もあるが、この場合、アンプ回路３１４内部にオフセット調整回路が必要となり、そのため回路規模は大となり、コストも高くなる。また前記従来技術では、ラダー抵抗３０７内に９個の可変抵抗１７０１～１７０９を具備し、その全ての可変抵抗の抵抗値を、ガンマ補正用制御レジスタ３０１で設定し、所望のガンマ特性に調整する構成である。この構成の場合、１つの可変抵抗値を調整すると、全体の抵抗分割比が変化し、これに伴い、全ての階調電圧が

変化する。従って、図１（ｃ）１０４～１０６のような個々の特性に完全に一致するように階調電圧を調整するには多くの時間を要する。

【００１４】本発明の目的は、高画質を実現する液晶駆動装置及び液晶表示装置を提供することである。

【００１５】

【課題を解決するための手段】上記課題であった液晶パネルの特性の相違に合わせ、階調番号の両端の電圧を調整可能とするため、本発明では、ラダー抵抗の両端部（外部から供給される基準電圧及びＧＮＤ間）にそれぞれ可変抵抗を設置し、その可変抵抗で抵抗分割された電圧から図１（ｃ）の１０７、１０８といった階調番号の両端の電圧を生成するようなラダー抵抗構成とした。また、上記可変抵抗の抵抗値をレジスタ（振幅調整レジスタと呼ぶ。）で設定可能とし、従来技術において、アンプ回路で行っていたオフセット調整についても、このラダー抵抗で調整可能とした。

【００１６】ここで、本発明では上述に限らず、この他の階調電圧においてもレジスタ設定で階調電圧を調整できるラダー抵抗構成とした。その各調整内容について、図２を用いて説明する。図２（ａ）は、振幅調整レジスタにより、ラダー抵抗の両端部の可変抵抗値を設定した各場合の階調番号－階調電圧特性について示している。ここで２０１は、階調電圧の低い側の電圧値は変化させずに、高い側の電圧値を変化させ、階調電圧の振幅電圧を調整した場合であり、２０２は階調電圧の高い側の電圧値は変化させずに、低い側の電圧値を変化させ、階調電圧の振幅電圧を調整した場合の特性図である。２０１、２０２は上記ラダー抵抗の両端部の可変抵抗値を振幅調整レジスタで片側（基準電圧側又はＧＮＤ側）だけを設定した場合である。また２０３は上記ラダー抵抗の両端部の可変抵抗値を振幅調整レジスタで同時に設定した場合の特性図である。この場合、従来技術においてアンプ回路で行っていたオフセット調整と同様の作用が得られる。

【００１７】次に図２（ｂ）の２０４は、階調番号－階調電圧特性の階調番号の中間（中間調）部の傾き特性を調整した場合の特性図である。この調整は傾き調整レジスタにより、ラダー抵抗内の傾き特性を決める階調電圧２０５、２０６を生成する可変抵抗の抵抗値を設定可能とすることで調整することができる。

【００１８】以上、振幅調整レジスタ及び傾き調整レジスタで図１（ｃ）の１０４～１０６といった各液晶パネルの特性に合わせた階調電圧を大まかに設定できる。これにより、各液晶パネルの特性に応じた所望のガンマ特性の調整が容易にでき、調整時間を短縮できる。

【００１９】次に図２（ｃ）の２０７は、各階調電圧を微調整した場合の階調番号－階調電圧特性図である。この微調整は、上記可変抵抗で抵抗分割された各階調電圧間に、さらに抵抗分割を行うための抵抗分割回路を設値し、その抵抗分割により生成された各電圧値の中から所望の階調電圧を微調整レジスタの設定値により選択できる構成とすることにより、微調整可能とする。この構成により、上記課題であった１つの可変抵抗値を変化させた場合においても、この可変抵抗により抵抗分割された各階調電圧間をさらに細かく抵抗分割し、その中から所望の電圧値を選択することで、他階調電圧をあまり変化させず、所望の階調電圧のみ調整可能となる。また上記のように各階調電圧の微調整を可能とすることで、ガンマ特性の調整をより精度の高いものとし、高画質化が望める。

【００２０】以上、ガンマ特性の調整において、振幅レジスタ、傾きレジスタの各設定で、液晶パネル個々の特性に応じた階調電圧の振幅電圧、及び中間調部の傾き特性といった大まか階調電圧を調整できるラダー抵抗構成とすることで、ガンマ特性の調整を容易とし、調整時間を短縮できるものとした。また微調整レジスタを具備することで、上記振幅レジスタ、傾きレジスタにて調整された階調電圧に対し、さらに微調整を行える構成とすることで、調整精度を高め、高画質化が望めるものとし、また調整範囲の自由度が増し、汎用性のあるものとした。

【００２１】

【発明の実施の形態】本発明の第１の実施形態による液晶表示装置の構成について、図３から図１０を用いて説明する。

【００２２】図３は本発明の階調電圧生成回路の構成図である。３０１はガンマ特性を調整するための設定値を保持する制御レジスタ、３０２は階調電圧生成回路、３０３は表示データに合わせた階調電圧をデコードするデコード回路である。ここで制御レジスタ３０１は上記振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０６を含んだ構成である。

【００２３】また階調電圧生成回路３０２は、外部から供給される基準電圧３１６とＧＮＤ間から各階調電圧を生成するラダー抵抗３０７、このラダー抵抗３０７を構成する可変抵抗３２１～３２４、及びその可変抵抗にて抵抗分割された電圧をさらに抵抗分割するための抵抗分割回路３２６～３３１、この抵抗分割回路３２６～３３１で生成された階調電圧を微調整レジスタ３０６の設定値により選択するセレクタ回路３０８～３１３、その各セレクタ回路の出力電圧をバッファリングするアンプ回路３１４及び、そのアンプ回路３１４出力電圧を所望の階調数分（ここでは例とし、６４階調電圧）の階調電圧に抵抗分割する出力部ラダー抵抗３１５により構成される。

【００２４】ここでラダー抵抗３０７の下側に設置されている下側可変抵抗３２１は、振幅調整レジスタ３０４の下側可変抵抗設定値３１７により、その抵抗値を設定できる構成とし、ラダー抵抗３０７の上側に設置されて

いる上側可変抵抗３２２は、振幅調整レジスタ３０４の上側可変抵抗設定値３１８により、その抵抗値を設定できる構成とする。この両可変抵抗３２１，３２２により抵抗分割された電圧を階調番号の両端の階調電圧とし、階調電圧の振幅調整を振幅調整レジスタ３０４で設定できる構成とする。

【００２５】またラダー抵抗３０７の中間部下段に設置されている中間部下側可変抵抗３２３は、傾き調整レジスタ３０５の中間部下側可変抵抗設定値３１９により、その抵抗値を設定できる構成とし、ラダー抵抗３０７中間部上側に設置されている中間部上側可変抵抗３２４は、傾き調整レジスタ３０５の中間部上側可変抵抗設定値３２０により、その抵抗値を設定できる構成とする。この両可変抵抗３２３，３２４により抵抗分割された電圧を中間調部の傾き特性を決めている階調番号の階調電圧とし、階調電圧の傾き特性を傾き調整レジスタ３０５で設定できる構成とする。

【００２６】上述のようなラダー抵抗構成とし、振幅調整レジスタ３０４、傾き調整レジスタ３０５により、ラダー抵抗内の可変抵抗値を設定することで抵抗分割比を変化させ、階調電圧の振幅電圧、及び中間調部の傾き特性を調整可能とする。（詳細作用については後に記述。）

また、振幅調整レジスタ３０４、傾き調整レジスタ３０５でそれぞれ設定された可変抵抗値により生成された階調電圧間を、抵抗分割回路３２６～３３１によりさらに細かく抵抗分割し、階調電圧を微調整するための微調整用階調電圧を生成する。次に、この微調整用階調電圧を各セレクタ回路３０８～３１３で、微調整レジスタ３０６の設定値３２５により、所望の階調電圧を選択する。この構成により、各階調電圧を微調整可能とし、ガンマ特性の調整精度を高め、調整の自由度も向上する（詳細作用は後に記述）。

【００２７】ここで、上述より生成される各階調電圧は後段のアンプ回路３１４でバッファリングされ、所望の６４階調の電圧を生成するため、出力部ラダー抵抗３１５で、その各階調電圧間を電圧関係がリニアとなるよう抵抗分割し、６４階調分の階調電圧を生成する。これにより階調電圧生成回路３０２で生成された６４階調の階調電圧は、デコード回路３０３で、表示データに合わせた階調電圧をデコードし、液晶パネルへの印加電圧となる。

【００２８】以上のような回路構成により、ガンマ特性の調整において、振幅レジスタ３０４、傾きレジスタ３０５の設定で、階調電圧の振幅電圧、及び中間調部の傾き特性といった大まかな階調電圧を調整可能なラダー抵抗を含み、そのラダー抵抗にて生成された階調電圧間から微調整レジスタ３０６の設定でさらに各階調電圧の微調整を行える構成とすることで、ガンマ特性の調整を容易かつ、調整時間を短縮でき、調整の精度及び自由度を向上させることで高画質化かつ、汎用性が望める階調電圧生成回路を小回路規模、低コストで実現した。

【００２９】次に、本実施形態で使用した図３の可変抵抗３２１～３２４について、レジスタ設定値と可変抵抗の動作について、図４を用いて説明する。図４において、４０１は上記可変抵抗３２１～３２４の内部構成を示したものである。ここでは、レジスタ（上記振幅調整レジスタ３０４、及び傾き調整レジスタ３０５）の設定値が１減少するごとに抵抗値が４Ｒ（Ｒ：単位抵抗値）増加するといった場合の可変抵抗の構成例である。ここで、４０２のようにレジスタ設定値が“１１１”［ＢＩＮ］という設定値であった場合、可変抵抗４０１内部の抵抗端に設置されたスイッチ４０３～４０５はスイッチＯＮとなり、可変抵抗４０１内部は短絡状態となる。よってこの時の可変抵抗４０１のトータル抵抗値は０Ｒとなる。尚ここで、各スイッチ４０３～４０５はレジスタのｂｉｔ毎に制御され、スイッチ４０３はレジスタ設定値の［２］ｂｉｔ目、スイッチ４０４はレジスタ設定値の［１］ｂｉｔ目、スイッチ４０５はレジスタ設定値の［０］ｂｉｔ目で、それぞれスイッチＯＮ、又はＯＦＦの制御をする。次に４０６のようにレジスタ設定値が“０００”［ＢＩＮ］という設定値であった場合、可変抵抗４０１内部の抵抗端に設置されたスイッチ４０３～４０５はスイッチＯＦＦとなり、可変抵抗４０１のトータル抵抗値は内部抵抗値の総和となる、トータル抵抗値は２８Ｒとなる。ここで上記構成におけるレジスタ設定値と可変抵抗値との関係は４０７に示した関係となる。

【００３０】尚、上記で示したレジスタ設定値と可変抵抗値との関係は一設定例であり、レジスタ設定値の各ｂｉｔを反転させた場合、上記レジスタ設定値と可変抵抗値との関係は逆になり、レジスタ設定値が増加すれば可変抵抗の抵抗値も増加するという関係となる。このようにレジスタ設定値と可変抵抗値との関係を逆にした場合でも構わない。またレジスタ設定値における可変抵抗値の変化割合を、１設定値毎に４Ｒとしているがこの値を小さくしたり、大きくしたりしても構わない。ここで、このレジスタ設定毎の抵抗値変化割合を小さくした場合、精度は向上するが調整範囲は狭くなり、逆に大きくした場合、調整範囲は広くなるが調整精度は悪化する。また、上記で使用した単位抵抗Ｒは数十ｋΩで構成することが望ましい（消費電流を少なくできる）。また上記レジスタ設定ｂｉｔ数は３ｂｉｔとしているがこの設定ｂｉｔ数を増加しても構わない。この場合、可変抵抗値の調整範囲は広くなるが回路規模は増加する。

【００３１】以上の構成により、レジスタ設定で可変抵抗の抵抗値を変化させることが可能である。

【００３２】次に図３の振幅調整レジスタ３０４とラダー抵抗３０７内の可変抵抗３２１、３２２によるガンマ特性の調整作用について、図５を用いて説明する。

【００３３】図５（ａ）は、図３のラダー抵抗３０７の

下側可変抵抗３２１を振幅調整レジスタ３０４で設定した場合の調整作用を示したものである。５０１は振幅調整レジスタ３０４がデフォルト設定とした場合の階調番号－階調電圧特性である。ここで、５０２のように階調電圧の高い側の電圧値は変化させずに、低い側の電圧値を変化させ、階調電圧の振幅電圧を小さく調整したい場合、振幅調整レジスタ３０４の設定を下側可変抵抗３２１の抵抗値が大となるように設定すれば良い。また５０３のように階調電圧の高い側の電圧値は変化させずに、低い側の電圧値を変化させ、階調電圧の振幅電圧を大きく調整したい場合、振幅調整レジスタ３０４の設定を下側可変抵抗３２１の抵抗値が小となるように設定すれば良い。

【００３４】このように振幅調整レジスタ３０４の設定で下側可変抵抗３２１の抵抗値を変化させることにより、階調電圧の高い側の電圧値は変化させずに、低い側の電圧値を変化させ、階調電圧の振幅電圧を調整することが可能である。

【００３５】次に同図５の（ｂ）は、図３のラダー抵抗３０７の上側可変抵抗３２２を振幅調整レジスタ３０４で設定した場合の調整作用を示したものである。５０１は上記同様、振幅調整レジスタ３０４がデフォルト設定とした場合の階調番号－階調電圧特性である。ここで、５０４のように階調電圧の低い側の電圧値は変化させずに、高い側の電圧値を変化させ、階調電圧の振幅電圧を小さく調整したい場合、振幅調整レジスタ３０４の設定を上側可変抵抗３２２の抵抗値が大となるように設定すれば良い。また５０５のように階調電圧の低い側の電圧値は変化させずに、高い側の電圧値を変化させ、階調電圧の振幅電圧を大きく調整したい場合、振幅調整レジスタ３０４の設定を上側可変抵抗３２２の抵抗値が小となるように設定すれば良い。

【００３６】このように振幅調整レジスタ３０４の設定で上側可変抵抗３２２の抵抗値を変化させることにより、階調電圧の低い側の電圧値は変化させずに、高い側の電圧値を変化させ、階調電圧の振幅電圧を調整することが可能である。

【００３７】次に同図５の（ｃ）は、上述した下側可変抵抗３２１、上側可変抵抗３２２を振幅調整レジスタ３０４で同時に設定した場合の調整作用を示したものである。５０１は上記同様、振幅調整レジスタ３０４がデフォルト設定とした場合の階調番号－階調電圧特性である。ここで、５０６のように階調番号－階調電圧特性、振幅電圧は５０１同様とし、上下の階調電圧値を高くしたい場合、振幅調整レジスタ３０４の設定を下側可変抵抗３２１の抵抗値を大、上側可変抵抗３２２の抵抗値を小に設定すれば良い。また５０７のように階調番号－階調電圧特性、振幅電圧は５０１同様とし、上下の階調電圧値を低くしたい場合、振幅調整レジスタ３０４の設定を下側可変抵抗３２１の抵抗値を小、上側可変抵抗３２２の抵抗値を大に設定すれば良い。

【００３８】このように振幅調整レジスタ３０４の設定で下側及び上側可変抵抗３２１、３２２を同時に設定した場合、振幅調整レジスタ３０４のデフォルト設定とした場合の階調番号－階調電圧特性にオフセット調整した特性となる。

【００３９】以上のことにより、図３の振幅調整レジスタ３０４により、液晶パネル個々の特性に合わせた階調電圧の振幅電圧を調整できる。

【００４０】次に図３の傾き調整レジスタ３０５とラダー抵抗３０７内の可変抵抗３２３、３２４によるガンマ特性の調整作用について、図６を用いて説明する。

【００４１】図６（ａ）は、図３のラダー抵抗３０７の中間部下側可変抵抗３２３を傾き調整レジスタ３０５で設定した場合の調整作用を示したものである。６０１は傾き調整レジスタ３０５がデフォルト設定とした場合の階調番号－階調電圧特性である。ここで、６０２のように階調電圧の高い側の傾き特性は変化させずに、階調電圧の低い側の電圧値を変化させ、階調電圧の中間調部の傾きが小になるように調整したい場合、傾き調整レジスタ３０５の設定を中間部下側可変抵抗３２３の抵抗値が大となるように設定すれば良い。

【００４２】また６０３のように階調電圧の高い側の傾き特性は変化させずに、階調電圧の低い側の電圧値を変化させ、階調電圧の中間調部の傾きが大になるように調整したい場合、傾き調整レジスタ３０５の設定を中間部下側可変抵抗３２３の抵抗値が小となるように設定すれば良い。

【００４３】このように傾き調整レジスタ３０５の設定で中間部下側可変抵抗３２３の抵抗値を変化させることにより、階調電圧の高い側の傾き特性は変化させずに、階調電圧の低い側の電圧値を変化させ、階調電圧の中間調部の傾きを調整することが可能である。

【００４４】次に同図６の（ｂ）は、図３のラダー抵抗３０７の中間部上側可変抵抗３２４を傾き調整レジスタ３０５で設定した場合の調整作用を示したものである。６０１は上記同様、傾き調整レジスタ３０５がデフォルト設定とした場合の階調番号－階調電圧特性である。ここで、６０４のように階調電圧の低い側の傾き特性は変化させずに、階調電圧の高い側の電圧値を変化させ、階調電圧の中間調部の傾きが小になるように調整したい場合、傾き調整レジスタ３０５の設定を中間部上側可変抵抗３２４の抵抗値が大となるように設定すれば良い。また６０５のように階調電圧の低い側の傾き特性は変化させずに、階調電圧の高い側の電圧値を変化させ、階調電圧の中間調部の傾きが大になるように調整したい場合、傾き調整レジスタ３０５の設定を中間部上側可変抵抗３２４の抵抗値が小となるように設定すれば良い。

【００４５】このように傾き調整レジスタ３０５の設定で中間部上側可変抵抗３２４の抵抗値を変化させること

により、階調電圧の高い側の電圧値を変化させ、階調電圧の中間調部の傾きを調整することが可能である。

【００４６】次に同図6の（ｃ）は、上述した中間部下側可変抵抗３２３、中間部上側可変抵抗３２４を傾き調整レジスタ３０５で同時に設定した場合の調整作用を示したものである。６０１は上記同様、傾き調整レジスタ３０５がデフォルト設定とした場合の階調番号－階調電圧特性である。ここで、６０６のように傾き特性は６０１同様とし、この傾き特性を決める階調電圧６０８の階調電圧値を高くしたい場合、傾き調整レジスタ３０５の設定を中間部下側可変抵抗３２３の抵抗値を大、中間部上側可変抵抗３２４の抵抗値を小に設定すれば良い。また６０７のように傾き特性は６０１同様とし、この傾き特性を決める階調電圧６０８の階調電圧値を低くしたい場合、傾き調整レジスタ３０５の設定を中間部下側可変抵抗３２３の抵抗値を小、中間部上側可変抵抗３２４の抵抗値を大に設定すれば良い。

【００４７】このように傾き調整レジスタ３０５の設定で中間部下側及び中間部上側可変抵抗３２３、３２４を同時に設定した場合、傾き調整レジスタ３０５のデフォルト設定とした場合の階調番号－階調電圧特性の傾き特性は同様とし、この傾き特性を決める階調電圧６０８の階調電圧値を調整した特性となる。

【００４８】以上のことにより、図3の傾き調整レジスタ３０５により、液晶パネル個々の特性に合わせた階調電圧の振幅電圧は変えず、中間調部の傾き特性のみを調整できる。

【００４９】次に本実施形態で使用した図3のセレクタ回路３０８～３１３について、微調整レジスタ３０６の設定値とセレクタ回路３０８～３１３との関係を図７を用いて説明する。

【００５０】図7において、７０１は上記セレクタ回路３０８～３１３の内部構成を示したものである。ここで７０２は、図3のラダー抵抗３０７内の抵抗分割回路３２６～３３１の内部構成を示したものであり、ここでは例として、抵抗値１Ｒで抵抗分割し、８つの微調整用階調電圧Ａ～Ｈを生成する場合の構成を示している。セレクタ回路７０１は、この抵抗分割回路７０２で生成された各微調整用階調電圧Ａ～Ｈのうち１階調電圧を微調整レジスタ３０６の設定値７０３により、選択する。

【００５１】上記セレクタ回路７０１は２ｔｏ１（２入力１出力）セレクタ回路で構成されており、レジスタ設定値７０３の［０］ｂｉｔ目で１段目のセレクタ回路群７０４の出力を選択し、［１］ｂｉｔ目で2段目のセレクタ回路群７０５の出力を選択し、［２］ｂｉｔ目で3段目のセレクタ回路７０６の出力を選択する。

【００５２】ここでレジスタ設定値７０３が“０００”［ＢＩＮ］と設定した場合、セレクタ回路７０１は抵抗分割回路７０２で分圧された微調整用階調電圧Ａを出力する。次にレジスタ設定値７０３が“１１１”［ＢＩＮ］と設定した場合、セレクタ回路７０１は抵抗分割回路７０２で分圧された微調整用階調電圧Ｈを出力する。このようにセレクタ回路７０１は、微調整レジスタ３０６のレジスタ設定値７０３が１増加するごとに、抵抗分割回路７０２で分圧された微調整用階調電圧をＡからＨへと順々に選択する。このレジスタ設定値７０３とセレクタ回路７０１で選択される微調整用階調電圧Ａ～Ｈとの関係を７０７に示す。

【００５３】尚、上記で示したレジスタ設定値とセレクタ回路との関係は一設定例であり、レジスタ設定値の各ｂｉｔを反転させた場合、上記レジスタ設定値とセレクタ回路との関係は逆になり、レジスタ設定値が増加すればセレクタ回路は微調整用階調電圧ＨからＡへと順々に選択する。このようにレジスタ設定値と可変抵抗値との関係を逆にした場合でも構わない。

【００５４】また、上記セレクタ回路はレジスタ設定ｂｉｔ数は３ｂｉｔとし、８つの微調整用階調電圧から１階調電圧を選択するものであるが、この設定ｂｉｔ数を増加して、選択できる階調数を増やしても構わない。この場合、階調電圧の微調整範囲は広くなるが回路規模は増加する。また抵抗分割回路内部の抵抗値を１Ｒとしているがこの値を小さくしたり、大きくしたりしても構わない。この抵抗分割回路内部の抵抗値を小さくした場合、微調整範囲は狭くなるが調整精度は向上する。また抵抗分割回路内部の抵抗値を大きくした場合、微調整範囲は広くなるが調整精度は悪化する。また、図４の可変抵抗構成と同様、単位抵抗Ｒは数十ｋΩで構成することが望ましい（消費電流を少なくできる）。

【００５５】次に図3の微調整レジスタ３０６とセレクタ回路３０８～３１３によるガンマ特性の調整作用について、図８を用いて説明する。

【００５６】図8において、８０１は微調整レジスタ３０６がデフォルト設定とした場合の階調番号－階調電圧特性である。また８０２は微調整レジスタ３０６の設定値をセレクタ回路３０８～３１３で選択される電圧値が最大となるよう設定した場合の特性図である。８０３は微調整レジスタ３０６の設定値をセレクタ回路３０８～３１３で選択される電圧値が最小となるよう設定した場合の特性図である。よって、上記８０２と８０３の間の電圧が微調整レジスタ３０６で設定できる微調整可能な階調電圧範囲である。ここで８０４～８０９はセレクタ回路３０８～３１３の出力（微調整可能な階調電圧）を示しておりそれぞれ、上記８０２と８０３の間の階調電圧範囲内で微調整可能である。

【００５７】以上のように図3の微調整レジスタ３０６の設定により、ラダー抵抗３０７内の抵抗分割回路３２６～３３１で生成された各微調整用階調電圧から１階調電圧を選択し、微調整可能とする。これにより、液晶パネル個々の特性に合わせた階調電圧の微調整可能とし、調整精度を向上することで高画質化が望める。

【００５８】上述で説明した振幅、傾き、微調整の３種類の調整レジスタを用いて、ガンマ特性を調整できる階調電圧生成回路を信号線駆動回路内に組み込んだ場合の液晶表示装置システム構成例を図９に示す。ここで図中の９００は本発明の液晶表示装置であり、９０１は液晶パネルであり、９０２は液晶パネル９０１の信号線に表示データに対応した階調電圧を出力する図３の階調電圧生成回路３０２を含んだ信号線駆動回路であり、９０３は液晶パネル９０１の走査ラインを走査する走査線駆動回路であり、９０４は上記信号線駆動回路９０２、走査線駆動回路９０３の動作電源を供給するシステム電源生成回路である。ここで、このシステム電源生成回路９０４から信号線駆動回路９０２に供給される電源電圧９０５内に図３の基準電圧３１６が含まれる。次に、９０６は液晶パネル９０１に画像を表示させるための各種制御及び各種処理を行うＭＰＵ（マイクロプロセッサユニット）であり、信号線駆動回路９０２は、このＭＰＵ９０６との表示データ並びに制御レジスタのデータのやりとりを行うシステムインターフェース９０７、システムインターフェース９０７より出力される表示データ９０８を一時保存しておくための表示メモリ９０９、及び図３で示した制御レジスタ３０１、階調電圧生成回路３０２、デコード回路３０３で構成される。尚、制御レジスタ３０１内部は図３でも示した振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０６を含む。

【００５９】上記ＭＰＵ９０６は、例えば汎用ＭＰＵである６８系１６ｂｉｔのバスインタフェースに準拠しており、チップ選択を示すＣＳ（ｃｈｉｐ　Ｓｅｌｅｃｔ）信号、制御レジスタ３０１のアドレスを指定するのかデータを指定するのかを選択するＲＳ（Ｒｅｇｉｓｔｅｒ　Ｓｅｌｅｃｔ）信号、処理動作の起動を指示するＥ（Ｅｎａｂｌｅ）信号、データの書込みまたは読出しを選択するR/W（Ｒｅａｄ／Ｗｒｉｔｅ）信号、制御レジスタ３０１のアドレスまたはデータの実際の設定値である１６ｂｉｔのＤａｔａ信号で構成される。これらの制御信号により、制御レジスタ３０１の各アドレスに対し、振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０６のレジスタ設定値が割振られ、制御レジスタ３０１のレジスタ内に設定データを各割り当てられたアドレスごと書き込み、又は読み出し動作を行う。

【００６０】次に図１０を用いてこのＭＰＵ９０６と信号線駆動回路９０２内部のインターフェース９０７間における各制御信号の動作について説明する。　まず、ＣＳ信号を“ロー”とし、制御レジスタ３０１をアクセス可能状態とする。ＲＳ信号を“ロー”時にはアドレス指定期間を意味し、ＲＳ信号“ハイ”時にはデータ指定期間を意味する。ここで制御レジスタ３０１への書き込み動作を行う場合、Ｒ／Ｗ信号を“ロー”とし、先のアドレス指定期間にＤａｔａ信号に所定のアドレス値を設定し、データ指定期間にそのアドレスのレジスタに書き込むデータ（上述での振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０６のレジスタ設定値等々）を設定する。その設定後Ｅ信号を一定期間“ハイ”にすることで制御レジスタ３０１にデータを書き込む。

【００６１】また制御レジスタ３０１に設定されたデータを読み出す際には、上記と同様にＣＳ、ＲＳ信号を設定し、Ｒ／Ｗ信号を“ハイ”とし、アドレス期間に所定のアドレスを設定し、上記同様、設定後Ｅ信号を一定期間“ハイ”とすることで、データ指定期間にレジスタ内に書き込まれたデータが読み出される。

【００６２】以上、制御レジスタ３０１のレジスタ内の各割り当てられたアドレスに振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０６のレジスタ設定値を書き込み動作を行うことで、上述したガンマ特性の調整において、上記各レジスタによる階調電圧の振幅電圧調整、中間調部の傾き特性調整、微調整が可能となり、ガンマ特性の調整が容易となり、また液晶パネル個々の特性に合わせた階調電圧を設定可能とする。

【００６３】次に、本発明の第２の実施形態による液晶表示装置の構成について説明する。

【００６４】まず、一般的に液晶パネルに階調電圧を印加する場合には、ある一定周期の交流信号（以下Ｍと称す。）で階調電圧を反転させて、液晶パネルを交流化駆動しなければならない。

【００６５】ここで液晶パネルの階調番号－階調電圧特性も、上記Ｍの極性ごとで異なり、そのＭの極性ごとに、所望のガンマ特性に調整しなければならないケースがある。ここで図１１に液晶パネルの交流化における階調番号－階調電圧特性の変化について示す。１１０１は、正極性（Ｍの極性がＭ＝０）時の階調番号－階調電圧特性である。ここで液晶パネルがノーマリーブラックモードの場合、階調番号が大きくなるにつれ、階調電圧は高くなるという特性を示している。１１０２は、負極性（Ｍの極性がＭ＝１）時の階調番号－階調電圧特性である。ここで階調番号が大きくなるにつれ、階調電圧は低くなるという特性を示している。ここで１１０１と１１０２は、センターライン１１０３を軸とし対称の関係となっている。このように正極性、あるいは負極性の階調番号－階調電圧特性が対称の関係であれば、前記した第１の実施形態による図３の階調電圧生成回路構成において、６４階調電圧の出力関係を反転（６４階調目の階調電圧を１階調目の階調電圧とし、１階調目の階調電圧を６４階調目の階調電圧と階調電圧と階調番号の関係を反転）すれば、正／負両極性においてガンマ特性の調整を行う必要は無い。しかし、液晶パネルによっては１１０４のような正／負極性で異なった階調番号－階調電圧特性となるケースがある。この場合、図３の第１の実施形

態による階調電圧生成回路構成では、所望のガンマ特性に調整するため、正／負極性の特性に応じ随時レジスタ設定を行わなければならない。そこで上記問題を解決するため、本第２の実施形態では、第１の実施形態同様の作用があるラダー抵抗を正極性用、負極性用に独立して具備し、ガンマ特性の調整を正／負両極性で行える構成とした。

【００６６】本発明の第２の実施形態による液晶表示装置の構成について図１２を用いて説明する。

【００６７】図１２は、前記第１の実施形態における図３の階調電圧生成回路３０２の内部構成のみを変更したものである。尚、制御レジスタ３０１やデコード回路３０３の構成及び動作については第１の実施形態と同様である。ここで図１２の階調電圧生成回路３０２は、第１の実施形態における図３のラダー抵抗３０７を正極性用ラダー抵抗１２０２、及び負極性用ラダー抵抗１２０３と正／負極性毎に独立して２本具備した構成としている。

【００６８】尚、この正／負極性用ラダー抵抗１２０２、１２０３は、第１の実施形態同様の作用を振幅調整レジスタ３０４、傾き調整レジスタ３０５のレジスタ設定により行える構成とする。

【００６９】ここで、この正／負両極性用ラダー抵抗１２０２、１２０３は、上記調整レジスタ３０４、３０５の設定値を共用し、その設定値により第１の実施形態同様に階調電圧の振幅電圧の調整、及び特性傾きの調整を正／負極性毎に行える構成とする。ここで、正極性用ラダー抵抗１２０２内部の抵抗値設定と負極性用ラダー抵抗１２０３内部抵抗値設定は上記調整レジスタ３０４、３０５の同設定で正極性、負極性で異なった階調電圧調整が行えるように異なった抵抗値設定とする。

【００７０】また上記のように正／負極性用ラダー抵抗１２０２、１２０３を２本具備することにより、図３におけるセレクタ回路３０８～３１３も正極性用セレクタ回路１２０４と負極性用セレクタ回路１２０５の２種類必要となる。ここで、正／負両極性用セレクタ回路１２０４、１２０５は、第１の実施形態である図３のセレクタ回路３０８～３１３と同構成とし、微調整レジスタ３０６設定により、第１の実施形態と同作用の微調整を可能とする。

【００７１】上記のような構成とし、Ｍ信号にて選択する極性セレクタ回路１２０１、１２０６により、正／負極性用ラダー抵抗１２０２、１２０３及び正／負極性用セレクタ回路１２０４、１２０５出力をＭの極性により選択する。尚、上記極性セレクタ１２０１、１２０６はＭ＝０時には正極性用ラダー抵抗１２０２、及び正極性用セレクタ回路１２０４出力を選択し、Ｍ＝１時には負極性用ラダー抵抗１２０３、及び負極性用セレクタ回路１２０５出力を選択する。

【００７２】以上のような階調電圧生成回路構成とし、第１の実施形態における図９同様の液晶表示装置システムに組み込むことで、正／負両極性のガンマ特性を独立して調整できる液晶表示装置を実現した。尚、各調整レジスタ３０４～３０６の設定値は、第１の実施形態と同様に図１０の制御信号により、制御レジスタ３０１内のアドレスにそれぞれ割り当て、各レジスタ設定値の書き込み動作を行うこととする。

【００７３】次に第３の実施形態による階調電圧生成回路構成を図１３に示す。ここで本実施形態は、上述第２の実施形態で２本構成としていたラダー抵抗を１本構成とし、第１の実施形態における振幅、傾き、微調整レジスタといった各調整レジスタを正／負極性独立させ具備し、正／負両極性のガンマ特性を独立して調整できるようにしたものである。ここで図１３は図３の第１の実施形態である階調電圧生成回路において、制御レジスタ３０１の内部構成のみを変更したものである。よって階調生成回路３０２やデコード回路３０３などの構成及び動作については前述第１の実施形態と同様である。ここで図１３の制御レジスタ３０１の内部について、１３０１は正極性用振幅調整レジスタ、１３０２は負極性用振幅調整レジスタ、１３０３は正極性用傾き調整レジスタ、１３０４は負極性用傾き調整レジスタ、１３０５は正極性用微調整レジスタ、１３０６は負極性用微調整レジスタであり、それぞれ正／負両極性で独立して設定できるものとする。これら調整レジスタ１３０１～１３０６はＭ信号により選択するセレクタ回路１３０７～１３０９により、正／負極性に応じたレジスタ１３０１～１３０６の設定値を選択する。ここでこのセレクタ回路１３０７～１３０９は、Ｍ＝０時には正極性用レジスタ１３０１、１３０３、１３０５の設定値を選択し、Ｍ＝１時には負極性用レジスタ１３０２、１３０４、１３０６の設定値をそれぞれ選択する。ここで正／負極性用振幅調整レジスタ１３０１、１３０２は図５で示した第１の実施形態による振幅調整レジスタと同等の作用が得られ、正／負極性用傾き調整レジスタ１３０３、１３０４は図６で示した傾き調整レジスタと同等の作用が得られ、正／負極性用微調整レジスタ１３０５、１３０６は図８で示した微調整レジスタと同等の作用が得られる。

【００７４】よって上述した正／負極性用調整レジスタ１３０１～１３０６により、正／負極性において、第１の実施形態と同様作用が得られることにより、液晶パネル個々の特性に合った階調電圧、及びガンマ特性の調整を、正／負両極性とも独立に調整できる構成とした。

【００７５】以上のような制御レジスタ３０１構成を図１４の液晶表示装置システムに組み込むことで、第２の実施形態よりも小回路規模で正／負両極性のガンマ特性を独立して調整できる液晶表示装置を実現した。尚、正／負極性用調整レジスタ１３０１～１３０６の設定値は、図１０と同様の制御信号により、制御レジスタ３０１内のアドレスに正／負極性用調整レジスタ１３０１～

１３０６をそれぞれ割り当て、各レジスタ設定値の書き込み動作を行うこととする。

【００７６】次に、本発明の第４の実施形態による液晶表示装置の構成について説明する。

【００７７】液晶パネルはその使用用途によって、バックライトを当てて画像を表示させる場合があり、この場合このバックライトＯＮ、又はＯＦＦにより液晶パネルの階調番号－階調電圧特性が変化するケースもあり、ガンマ特性の調整も行う必要がある。本実施形態では、上述のようなバックライトＯＮ／ＯＦＦ時におけるガンマ特性の調整方法について、図１５を用いて説明する。

【００７８】図１５は図９の第１の実施形態における液晶表示装置システム構成図において、ＭＰＵ９０６及び信号線駆動回路９０２内の制御レジスタ３０１内部を変更したものであり、他ブロックの構成、及び動作については第１の実施形態同様である。但し、液晶パネル９０１は上述のバックライト回路を含むものとする。ここで、ＭＰＵ９０６内部には上記バックライトＯＮ／ＯＦＦを判別するバックライトＯＮ／ＯＦＦ判別手段１４０１を設け、制御レジスタ３０１には、前記第１の実施形態と同様の作用を持つ、振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０５を含んだバックライトＯＮ時のレジスタ１４０２と上記同レジスタを含む、バックライトＯＦＦ時レジスタ１４０３とを独立して具備する。ここで先のバックライトＯＮ／ＯＦＦ判別手段１４０１から出力されるバックライトＯＮあるいはバックライトＯＦＦ状態を示す判別信号１４０４により、上記バックライトＯＮ時レジスタ１４０２とバックライトＯＦＦ時レジスタ１４０３の設定値をセレクタ回路１４０５で選択し、このセレクタ回路１４０５で選択されたレジスタ設定値を第１の実施形態と同構成である階調電圧生成回路３０２内で使用する。

【００７９】以上のように制御レジスタ３０１内に第１の実施形態と同様の作用を持つ振幅、傾き、微調整レジスタをバックライトＯＮ時、及びバックライトＯＦＦ時用に２種類具備する構成とすることにより、バックライトＯＮ／ＯＦＦによる液晶パネル個々の特性におけるガンマ特性の調整についても、個別に調整でき、高画質化が望める液晶表示装置を実現した。尚、バックライトＯＮ時のレジスタ１４０２、及びバックライトＯＦＦ時レジスタ１４０３の設定値は、第１の実施形態と同様に図１０の制御信号により、制御レジスタ３０１内のアドレスにそれぞれ割り当て、各レジスタ設定値の書き込み動作を行うこととする。

【００８０】次に、本発明の第５の実施形態による液晶表示装置の構成について説明する。

【００８１】本実施形態は、液晶パネルの表示色である赤、緑、青（以下Ｒ、Ｇ、Ｂと称す。）ごとにガンマ特性を個別に調整できるようにしたものであり、その構成について図１６を用いて説明する。

【００８２】図１６は第４の実施形態の図１５同様、図９の第１の実施形態における液晶表示装置システム構成図において、制御レジスタ３０１の内部構成のみを変更したものであり、他ブロックの構成、及び動作については第１の実施形態同様である。ここで上記Ｒ、Ｇ、Ｂのガンマ特性を個別に調整するため、制御レジスタ３０１内に、Ｒ用調整レジスタ１６０１、Ｇ用調整レジスタ１６０２、Ｂ用調整レジスタ１６０３を独立して具備する構成とした。ここで上記調整レジスタ１６０１～１６０２はいずれも、第１実施形態と同様の作用が得られる振幅調整レジスタ３０４、傾き調整レジスタ３０５、微調整レジスタ３０６を含む。以上のように、制御レジスタ３０１内に第１の実施形態と同様の作用を持つ振幅、傾き、微調整レジスタを含む、Ｒ用、Ｇ用、Ｂ用調整レジスタ１６０１～１６０３といった液晶パネルの表示色毎に独立してレジスタ具備する構成とすることにより、液晶パネルの表示色Ｒ、Ｇ、Ｂ各色のガンマ特性を個別で調整可能とし、より高画質化が望める液晶表示装置を実現した。尚、Ｒ用、Ｇ用、Ｂ用調整レジスタ１６０１～１６０３の設定値は、第１の実施形態と同様に図１０の制御信号により、制御レジスタ３０１内のアドレスにそれぞれ割り当て、各レジスタ設定値の書き込み動作を行うこととする。

【００８３】本発明は以上に示した実施形態に限定されるものでは無く、種々の変更が可能である。例えば、上述では、液晶パネルのモードをノーマリーブラックモードを前提として説明を行ったが、本発明は上記液晶パネルのモードに関係なく実施できる。また階調数を６４階調を前提として説明を行ったが、本発明は他階調数に関係なく実施可能である。

【００８４】上記本発明の第１～第５の実施形態によれば、ガンマ特性の調整において、振幅調整レジスタ、傾き調整レジスタを具備し、そのレジスタ設定により、液晶パネル個々の特性に応じた階調電圧の振幅電圧、及び中間調部の傾き特性といった大まか階調電圧を調整可能なラダー抵抗構成を具備することで、ガンマ特性の調整を容易とし、調整時間を短縮できる。また上記各調整をラダー抵抗で行えることとすることで小回路規模、かつ、低コストの効果がある。

【００８５】また、振幅レジスタ、傾きレジスタに加え、微調整レジスタを具備することで、上記レジスタにて調整された階調電圧に対し、さらに微調整を行える構成とすることにより、調整精度を高め、高画質化が望める効果がある。

【００８６】また、上記本発明の第１～第５の実施形態によれば、液晶パネル個々の特性に合わせたガンマ特性の調整が可能になるので、汎用性のある回路構成が構築できる効果がある。

【００８７】

【発明の効果】本発明によれば、液晶表示装置のガンマ

特性の調整精度が向上され、これにより、画質を向上するという効果を奏する。

【図面の簡単な説明】

【図１】代表的な液晶パネルのガンマ特性図

【図２】本発明のガンマ特性の調整内容

【図３】本発明の第１実施形態による階調電圧生成回路構成図

【図４】本発明の実施形態に使用した可変抵抗構成図

【図５】本発明の振幅調整レジスタ設定によるガンマ特性の調整作用

【図６】本発明の傾き調整レジスタ設定によるガンマ特性の調整作用

【図７】本発明の実施形態に使用したセレクタ回路構成図

【図８】本発明の微調整レジスタ設定によるガンマ特性の調整作用

【図９】本発明の第１実施形態による液晶表示装置のシステム構成図

【図１０】本発明のレジスタ設定フロー図

【図１１】液晶パネルの非対称ガンマ特性図

【図１２】本発明の第２実施形態による階調電圧生成回路構成図

【図１３】本発明の第３実施形態による階調電圧生成回路構成図

【図１４】本発明の第３実施形態による液晶表示装置のシステム構成図

【図１５】本発明の第４実施形態による液晶表示装置のシステム構成図

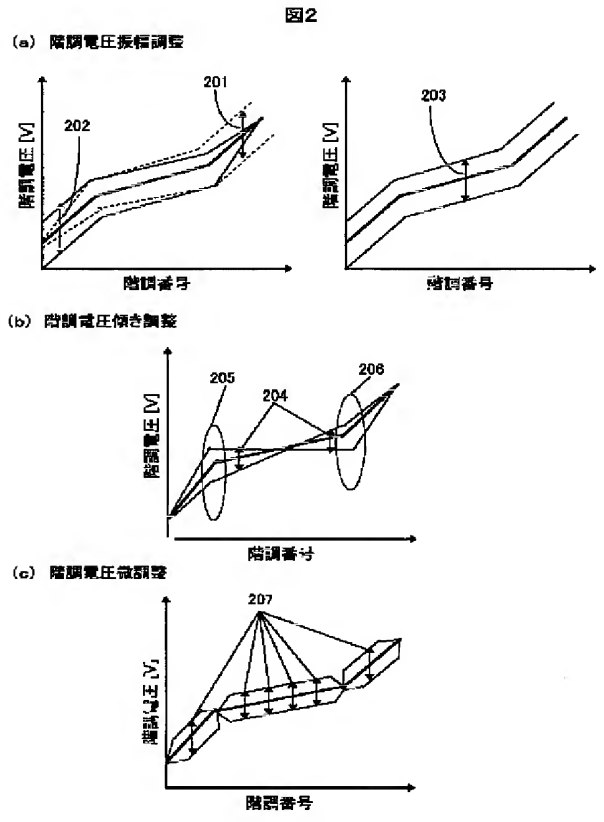
【図１６】本発明の第５実施形態による液晶表示装置のシステム構成図

【図１７】従来技術のガンマ調整回路概略図

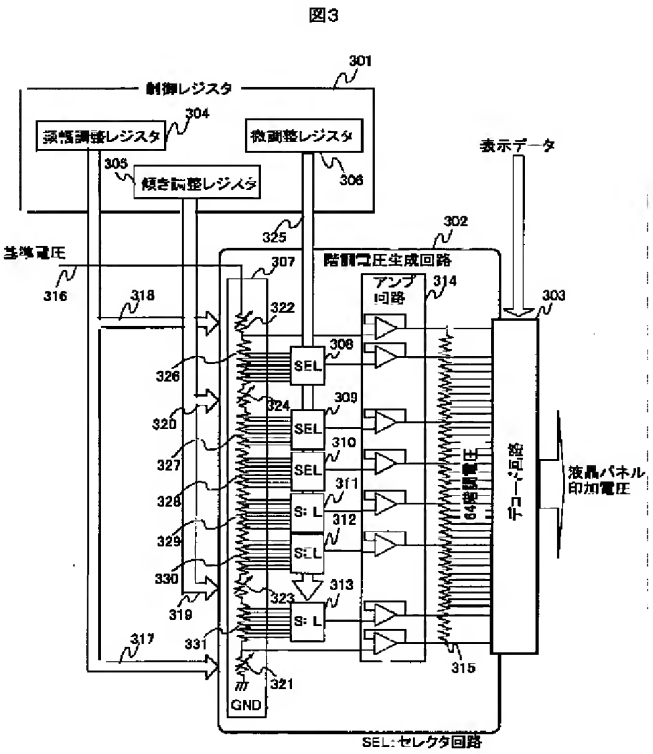
【符号の説明】

３０１…制御レジスタ、３０２…階調電圧生成回路、３０３…デコード回路、３０４…振幅調整レジスタ、３０５…傾き調整レジスタ、３０６…微調整レジスタ、３０７…ラダー抵抗、３０８～３１３…セレクタ回路、３１４…アンプ回路、３１５…出力部ラダー抵抗、３１６…基準電圧、３１７…下側可変抵抗設定値、３１８…上側可変抵抗設定値、３１９…中間部下側可変抵抗設定値、３２０…中間部上側可変抵抗設定値、３２１…下側可変抵抗、３２２…上側可変抵抗、３２３…中間部下側可変抵抗、３２４…中間部上側可変抵抗、３２５…微調整レジスタ設定値、３２６～３３１…抵抗分割回路。

【図２】

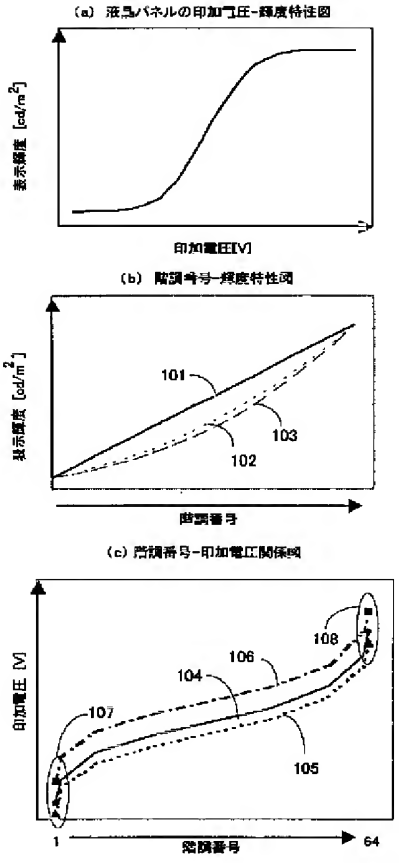


【図３】



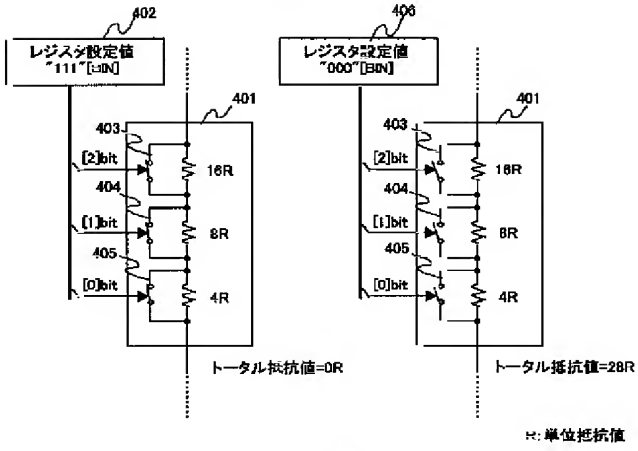
【図１】

図1



【図４】

図4



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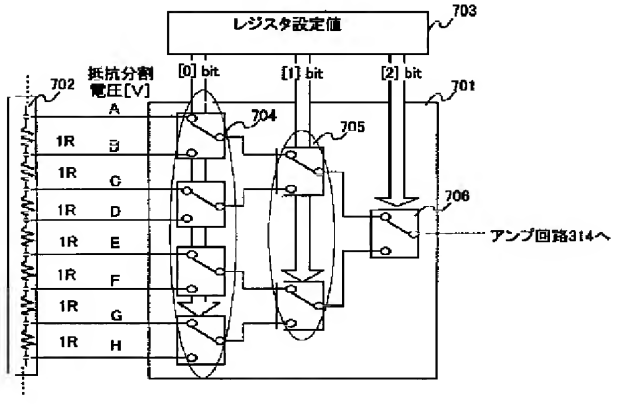
レジスタ設定値[BIN]	可変抵抗値
111	0R
110	4R
101	8R
100	12R
011	16R
010	20R
001	24R
000	28R

【図７】

図7



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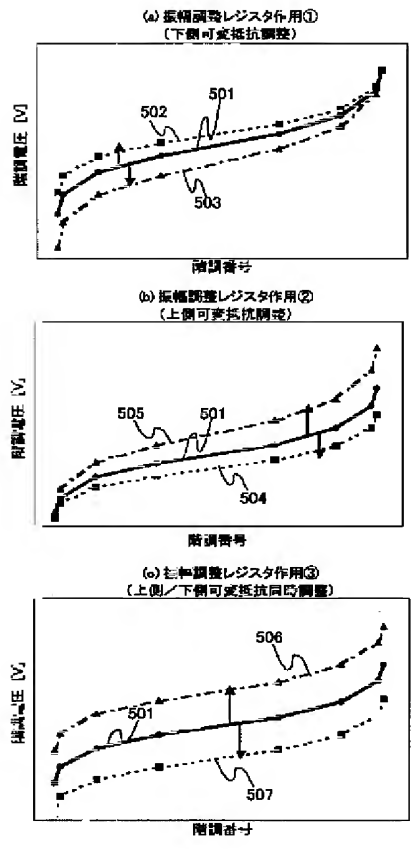
レジスタ設定値[BIN]	抵抗分割電圧[V]
111	H
110	G
101	F
100	E
011	D
010	C
001	B
000	A

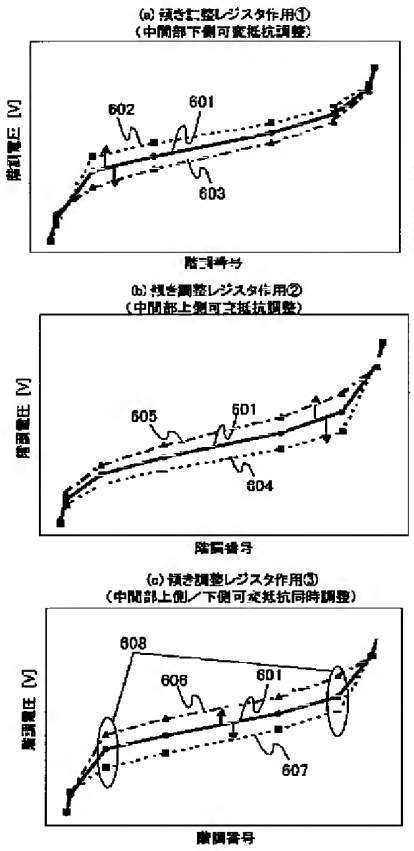
【図5】

図5



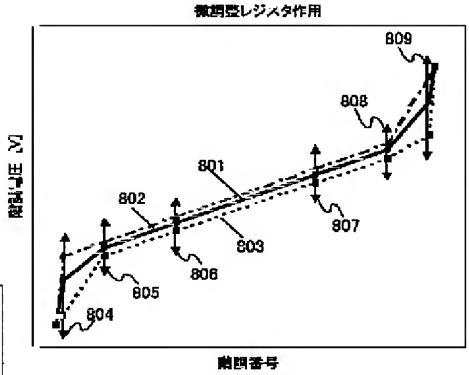
【図6】

図6



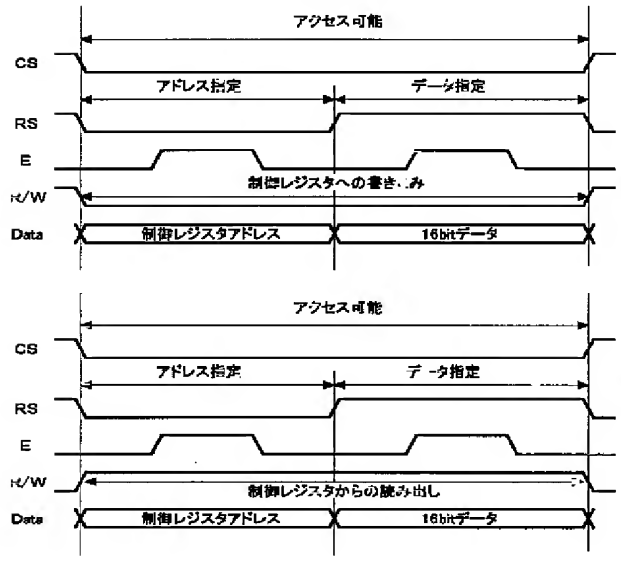
【図8】

図8



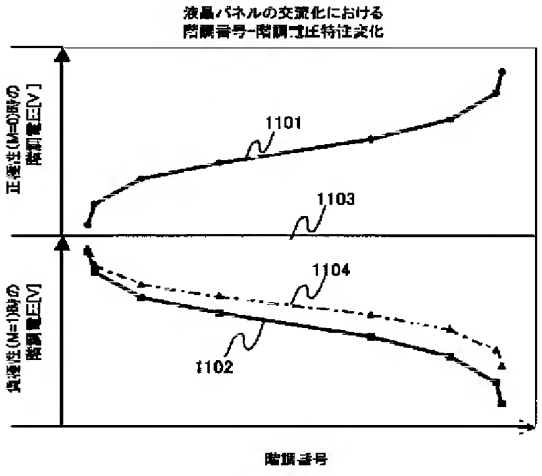
【図10】

図10



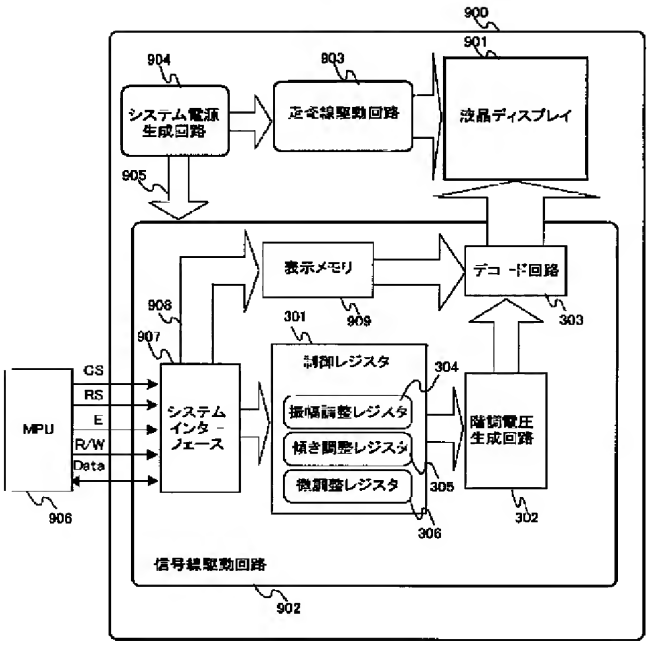
【図11】

図11



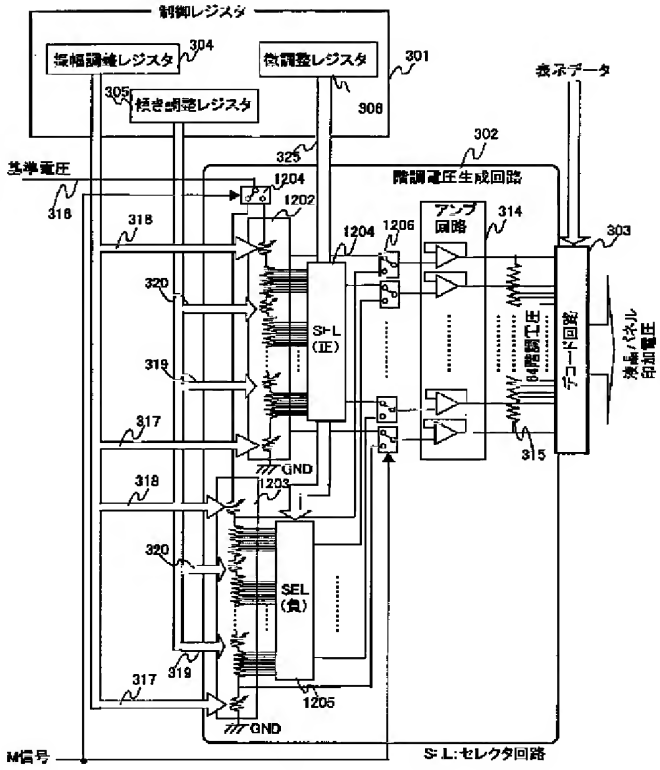
【図9】

図9



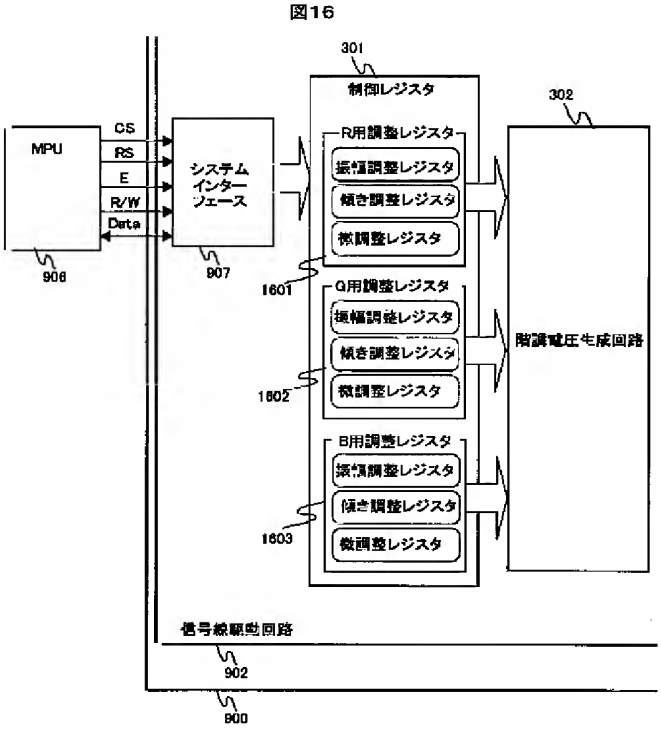
【図12】

図12



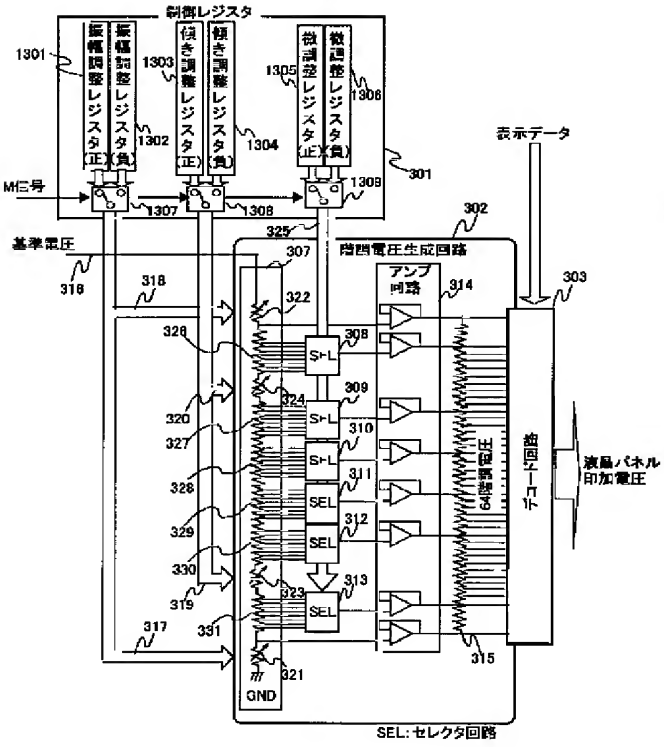
【図16】

図16



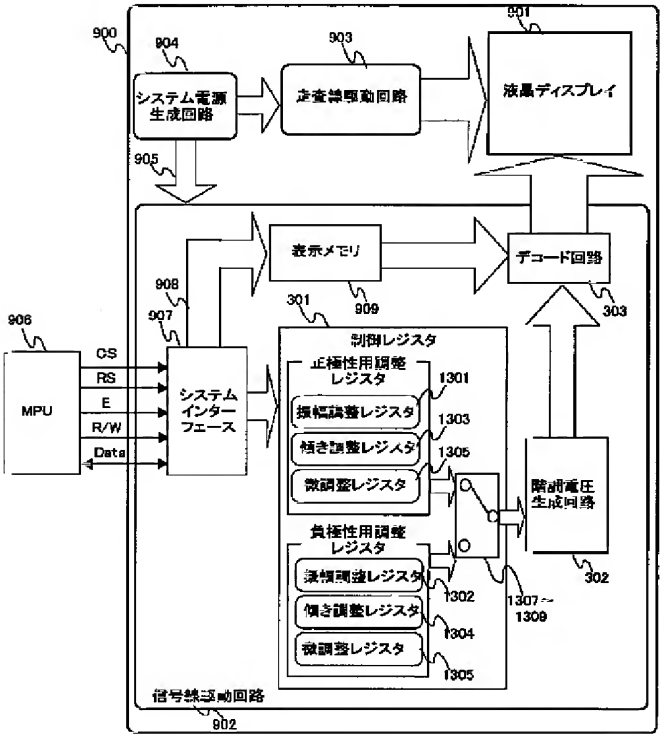
【図１３】

図13



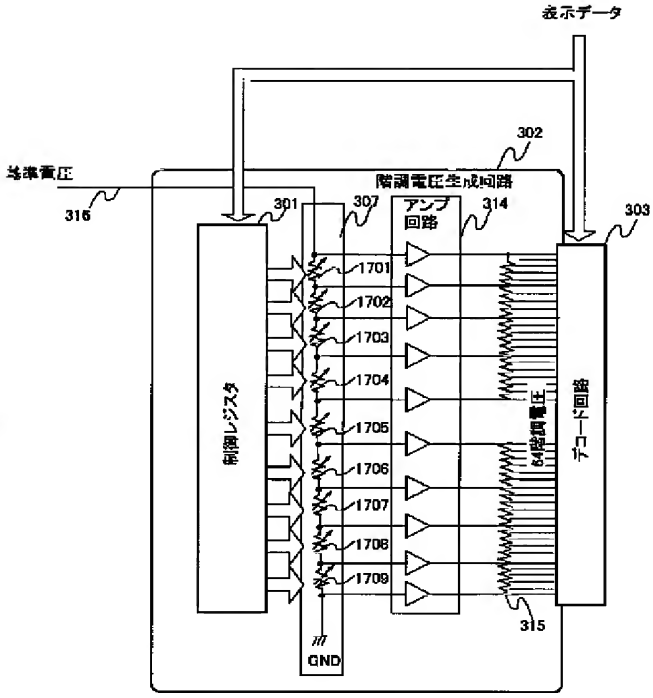
【図１４】

図14



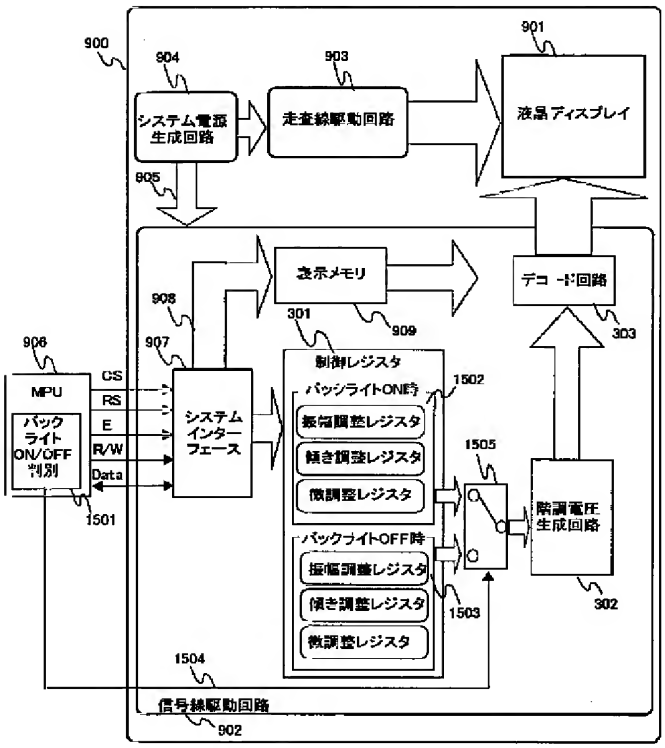
【図１７】

図17



【図15】

図15



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